INSTITUTIONS
OF
ASTRONOMICAL
CALCULATIONS:

CONTAINING,

I. A *New* SET of SOLAR TABLES for computing the SUN's *True* PLACE, by Mr. TOBIAS MAYER, who verified every *Element* thereof by his own Obſervations.

II. A *New* SET of LUNAR TABLES, calculated from the THEORY of *Univerſal* GRAVITATION, of an intire new Form, and the moſt commodious for *Aſtronomical Calculations*, and verified by 200 Obſervations; from the Second Quarto Edition at *Paris*, 1765, by the late celebrated Mr. CLAIRAUT, FELLOW of the ROYAL ACADEMIES of SCIENCES of *Paris*, *London*, *Peterſbourg*, *Berlin*, *Bologne*, and *Upſal*.

III. A General EXPOSITION or *Rationale* of the Nature, Conſtruction, and Uſe of *Aſtronomical* TABLES, and of the PRECEPTS of CALCULATION in *Solar and Lunar* ECLIPSES, with the Doctrine of *Shadows*, and their Delineation on the Surface of the EARTH, conſidered both as a SPHERE and a SPHEROID; a Work intirely new, illuſtrated with Three large COPPER PLATES.

By BENJAMIN MARTIN.

LONDON
Printed for and Sold by the AUTHOR in FLEET-STREET
and all Bookſellers in City and Country.
M.DCC.LXV.

1651/535
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INTRODUCTION.

THE Fundamentals of ASTRONOMY having been largely treated of and explained in ſeveral preceding Parts of theſe INSTITUTIONS, where they were found moſt naturally to ariſe; the Principles relative to the practical Part now remain to be ſtated and illuſtrated; which therefore will furniſh a Syſtem of INSTITUTIONS *of* ASTRONOMICAL CALCULATIONS for the Subject Matter of the Third Volume of theſe *Phyſico-Mathematical* INSTITUTES.

Not that I ſhould have troubled the Public with any thing more upon this Head, if I had found nothing that was not *quite new* and *quite neceſſary* for public Good, to juſtify ſuch an Undertaking. I believe at this Time of the Day all Aſtronomers and Navigators are pretty well convinced in what an imperfect State all our *Lunar Tables* are, that have been hitherto publiſhed by the moſt able Authors; nor will this appear at all ſtrange, if it be conſidered how very few *Lunar Equations* thoſe Tables contain, out of the great Numbers that really exiſt in Nature.

Our modern Aſtronomers being fully appriſed of this Matter, and knowing there was no Remedy but an analytical Reſolution of that arduous *Problem of Three Bodies*, (as it was

called),

called) immediately addreſſed themſelves to the great Undertaking; EULER, MAYER, D'ALEMBERT, CLAIRAUT abroad, and the late Mr. SIMPSON at home. What Succeſs has attended others, muſt be left to Time to diſcover; but Mr. CLAIRAUT has ſo far completed the Deſign, as to have publiſhed a *Second Edition* of a *New* SET of TABLES of the MOON'S MOTIONS, calculated according to the THEORY of *Univerſal* GRAVITATION.

Theſe TABLES, together with the THEORY at large, and his *New* RESEARCHES thereupon, were publiſhed the Beginning of the preſent Year 1765 at PARIS, in a large Quarto Volume in *French*, and much more correct than thoſe of the *Firſt Edition*. And it is this Set of Tables that I now preſent to my Countrymen in their own Language and Dreſs.

To prejudice the Reader in favour of theſe Tables, by Encomiums on the Author, would be vain; it is ſufficient to ſay, that his Theory, from whence they are deduced, obtained the PRIZE offered by the IMPERIAL ACADEMY at PETERSBOURG for the Solution of this Queſtion, *viz. Whether all the Inequalities obſerved in the Motion of the Moon were conſentaneous to the* Newtonian *Theory? and what may be the true Theory of all thoſe Inequalities, from whence the Place of the Moon for any propoſed Time may be moſt exactly defined?*

Hence it appears that a good Set of Lunar Tables can only be furniſhed by a Theory which takes in all the Caſes and Circumſtances of Gravitation between the *Sun*, *Earth*, and *Moon*; and ſhews the numerous Inequalities which naturally reſult from thence, reſpecting the Motion of the Satellite or Moon, and how they may be truly eſtimated. Such a Theory, then, is that of Mr. *Clairaut* by public Conſent; and his Tables, of courſe, are ſuch as will give the Moon's Place moſt exactly defined for any Time propoſed.

I believe there is very little Reaſon to expect we ſhall ever have better Tables than theſe; for the *Lunar Theory* itſelf can afford but a given Degree of Perfection, which will always be the ſame if the ſame Number of Terms in the Infinite Series expreſſing the Moon's true Place be taken. Theſe Tables take in 20 of thoſe Terms; and to take in more would be to no Purpoſe, as theſe are ſufficient for greater Accuracy in general than is required by the *Aſtronomer* and *Navigator* in their uſual Computations.

I know of no Cauſe of Difference or Preference in *Lunar Tables* derived from the Theory by the Rules of Analyſis, but the *Skill and Accuracy* of the *Calculator*. But who in this reſpect can compare with our Author? When the great SIMPSON (ſome Years ago) engaged in the ſame Deſign, ſaw Mr. *Clairaut*'s Performance, he at once deſiſted from his own. If SIMPSON's Genius, aſſiſted by Dr. *Bradley*'s Obſervations, could not do better than what had been done by Mr. CLAIRAUT, who have we left to put in Competition with this moſt learned and celebrated Aſtronomer, and MEMBER of the ROYAL ACADEMIES OF SCIENCES of PARIS, of LONDON, of PRUSSIA, of RUSSIA, of BOLOGNE, and of UPSAL?

But ſuppoſing the Author's Capacity ever ſo great as a Computiſt, yet we have a Right to expect they ſhould ſtand the Teſt of the ſevereſt Trial by the *Law and the Teſtimony of Nature*, that is, by comparing the Places, Latitudes, Longitudes, *&c.* of the Moon found by Obſervations, with thoſe calculated by the Tables for the ſame Times. In this Regard no Man was more vigilant and ſcrupulous than our Author; his great Aſſiduity and unparallelled Patience in calculating his Tables were equally conſpicuous in verifying of them by Obſervations.

To this End he has collected about 200 Inſtances of the Latitudes and Longitudes of the Moon made at different Times by Dr. BRADLEY and Meſſieurs CASSINI and MIRALDI; and by Computations from his Tables it appears, that in regard to the Moon's Latitude there were but Nine Differences which amounted to more than a ſingle Minute of a Degree, and not one that exceeded 1′ 22″.——As to the Differences in regard to her *Longitude*, there were out of the 200 but 23 which exceeded a Minute, and not one that amounted to $1\frac{1}{2}$ Minute: An Agreement and Coincidence of Tables and Obſervations as was never known before.

But though ſuch an Approximation of Art to Nature may appear juſtly ſurpriſing, yet I ſee no Reaſon why thoſe Differences (ſmall as they are) ſhould be ſuppoſed wholly owing to the Tables. Who does not know the Imperfection of the beſt Inſtruments for *meaſuring Arches and Angles to Seconds*? How eaſy for a BRADLEY himſelf to ſlip a few Seconds ſometimes in ſuch lubricous Situations as the Obſerver often finds himſelf? If therefore Obſervations can be ſuppoſed in any Degree faulty, how little Imperfection will then remain to be imputed to theſe Tables!

It is very remarkable that theſe Tables ſo accurately agree with near 100 Obſervations of Dr. *Bradley*, that there is but *one* in the Moon's Latitude where they differ one Minute; and only nine ſuch Differences in her Longitudes. Our Author might therefore very juſtly ſay, that by his Tables one might be able *to find the* LONGITUDE *at* SEA *to nearly* $\frac{3}{4}$ *of a Degree*, when the Obſervation is properly made, *viz. by taking the Mean of ſeveral.*

From the Nature of *infinite converging Series* it is plain, that Tables conſtructed on ſuch Principles, are capable of almoſt any Degree of Preciſion you will be at the Pains to give them, from a greater Number of Terms; Mr. MAYER has publiſhed Tables of the ſame Kind with theſe, but with only *thirteen* Equations or Corrections of the Moon's Mean Place, which therefore cannot be ſo accurate as theſe which have 20 of the ſaid Equations; and they that ſhall add to theſe four or five more, will for their Reward have the Satisfaction to find, what that farther Improvement will amount to.

That I may convey ſome Sort of an Idea of this Affair to thoſe who are not *mathematically* learned, let it be conſidered, that the Series of Fractions $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$, $\frac{1}{128}$, $\frac{1}{256}$, *&c.*

continued in the ſame decreaſing Ratio to Infinity, would have the Sum of *all its infinite Number of Terms* equal to Unity or 1. But the *Ten firſt Terms* of the Series are ſo nearly equal to unity, as to differ from it by leſs than $\frac{1}{1000}$ Part; therefore all the following Terms of that infinite Series do not amount to $\frac{1}{1000}$ Part of an Unit.

Thus Mr. CLAIRAUT having thoroughly examined every Source, in the various Branches of the Theory, from whence ny ſenſible Increaſe to the reſpective Terms of his Series could ariſe, he found thoſe Terms could not be reduced to a leſs Number than 20; and imputes ſome Deficiencies he had obſerved in *Mayer's* Tables to his having ſacrificed ſeveral ſmall Equations (by no means to have been neglected) to abridge the Operation, and leſſen the Number of his Tables.

Having ſaid what I think neceſſary concerning the eſſential Goodneſs and intrinſic Value of this new Set of Lunar Tables, I ſhall next obſerve, that there are ſuch material Circumſtances attending them which cannot but conduce to conciliate a proper Regard and juſt Eſtimation from every conſiderate Reader.

The firſt I ſhall mention is their being of a Form intirely new, and the moſt commodious poſſible in Practice. This conſiſts in rendering all the Equations *affirmative*; by this means, though they are numerous, yet by an eaſy *Addition* only they are collected into *one Sum*, without the leaſt Labour or Fatigue to the Calculator; his Mind is now no longer tortured and perplexed with *heterogeneous* Quantities, ſome to be *added*, others to be *ſubtracted*, whoſe *Sums* and *Differences* are at laſt to be collected, to obtain the equated Place of the Object. I can venture to ſay from Experience, that though theſe Tables for finding the Moon's Place are three times more in Number than the common Tables hitherto uſed, yet I can make the Calculation in a third Part of the Time, and with infinitely more Eaſe and Pleaſure, than by the uſual Methods.

It ſeems to me that our Author's Invention of this moſt excellent Artifice was owing to the Intricacy and Difficulty of the Computation from Tables of this Conſtruction, in th uſual Manner of *Affirmative* and *Negative* Equations, as they ſtand in *Mayer*'s Collection; a bare View of the Example of the Moon's Place equated in each, will be ſufficient to convince every intelligent Reader of the unparalleled *Obſcurity* of the one, and *Perſpicuity* of the other.

But what conduces ſtill more to the Eaſe of Calculation by theſe Tables of Mr. CLAIRAUT, is, that you have not only the Equations themſelves, but even the very *Arguments* of each, ready calculated to your hand; indeed, if any one would be appriſed of the prodigious advantage he has in this reſpect, he muſt try the Experiment of a Calculation o the Moon's Place by *Mayer*'s Forms and theſe at the ſa time.

Another Circumſtance greatly in favour of theſe new Ta is, that being derived from a *Phyſico-Mathematical Theo* they carry as it were a Radiance of Light and Truth about them; you do not here grope after the Luminary in the Dark; you have a perſpicuous Rationale for what you do. Indeed this is upon Suppoſition that you underſtand the Principles of the Lunar Theory, at leaſt as far as they are here premiſed to theſe Tables for that Purpoſe.

The laſt circumſtantial Recommendation of theſe new Tables is, that Mr. CLAIRAUT was aſſiſted in the tedious Taſk of computing, ordering, and forming them, by no leſs a Co-adjutor than the late moſt learned and celebrated *Aſtronomer*, the Abbé DE LA CAILLE. To two ſuch Names as theſe what Arguments can be added to recommend any Work, in the *Aſtronomical* Kind, to all the World? Such reſpectable Characters gagg the Mouths of Envy and Intereſt, and extort Approbation even from *Momus* himſelf.

But from direct and circumſtantial Evidence, let us next appeal to *Fact*, and from thence derive a *poſitive Proof* or *real Demonſtration* of the Perfection of theſe Tables, or the Proximity to Nature. The *Teſt* for this Purpoſe is, the late memorable annular ECLIPSE of the Sun, *April* 1, 1764. The Phaſes of this Eclipſe at *London* almoſt exactly anſwer, both in *Quantity* and *Time*, to what they are found to be by the following Calculation from theſe Tables, as inconteſtably appears by the Number of Obſervations made in and about *London*, printed in the laſt Vol. of Philoſ. Tranſactions for the Year 1764; particularly that of the late Rev. Mr. BLISS, Aſtronomer Royal.

In ſhort, I am fully perſuaded no Set of Lunar Tables ever yet appeared, which merited the public Regard, in Point of Correctneſs, in any Compariſon with theſe. And if they meet with the Reception from the literary World which they deſerve, and can maintain their Ground till others of greater Worth and Pre-eminence can diſplace them, it is all the Editor can wiſh for.

With regard to the Correctneſs of the Preſs, I have carefully obſerved that every Figure through the Tables agreed with the Original, except in the *Errata*, which were but a few, and ought to have been corrected in the *French* Edition. One great advantage in this *Engliſh* Edition is, that the Type is much larger than in the Original, and the Tables of courſe much eaſier to the eye, as well as more diſtinct; and therefore leſs liable to occaſion any Miſtakes in Practice.

The whole enſuing Diſcourſe being only a general Expoſition and Illuſtration of the Nature, Conſtruction, and Uſe of the Tables, particularly in regard to *Solar and Lunar Eclipſes*, I ſhall not detain the Reader with any Detail of what I have done or added on that Head; only one Thing ought to be obſerved, *viz.* That the Phaſes and Aſpects of the heavenly Bodies are to be accommodated to the Spectator's Eye on the Surface of the Earth, conſidered as a *flatted* SPHEROID; for this Purpoſe, I have given ſuch Precepts and Inſtructions as were thought neceſſary in a Subject of ſo important a Nature.

The *Dimenſion* of the ſeveral Parts of the *Shadow* on the Earth's Surface being abſolutely neceſſary to a *Geographical*

Delineation or *Map* of the ſame, I have delivered that doctrine ſuccinctly from the Principles of Orthographic Projection; and becauſe I have not yet ſeen a Map of the Shadow of the laſt Eclipſe, which I can any-ways apprehend to be a juſt Repreſentation of it, I have given one which I think to be ſuch, with ſome other Reaſons than my bare *Ipſe dixi* to induce the thinking Part of Mankind to have the ſame Opinion of it likewiſe.

I had ſome Thoughts of adding one Chapter more on the Subject of the Perturbating Forces of the MOON, VENUS, and JUPITER, as our Author has given us a Theory of them alſo, and Tables of their Equations; but conſidering in how ſmall a Degree the Phænomena of Eclipſes are affected by them, I judged it not worth while to trouble the young Aſtronomer with them here; but as in ſome other Parts of this Science they are too ſenſible to be diſregarded, we may take an Opportunity of treating of them fully in the future Proſecution of theſe *Inſtitutions of Aſtronomical Calculations*, if what is now offered to the Public meets with an encouraging Reception.

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CORRIGENDA.

In Table III. Page VI, at the Bottom of the Column of Feb. eraſe the Words, *After Jan. Feb. ſubduct one Day.*

In Tab. V. Page x, at the Top of the Side Columns write, ☉ *Mean Anom.*

ADVERTISEMENT.

MR. *Martin* thinks it expedient to acquaint the GENTLEMEN of the MARINE, that his *Celeſtial* GLOBE of twenty-eight Inches Diameter is capable of ſuch a Conſtruction as muſt render it extremely uſeful at Sea, from the great Degree of Exactneſs with which any CASE of SAILING may be practically repreſented upon it, and immediately ſolved, without any Difficulty or Fatigue, by any common Mariner, who does but know what is meant by a *Spherical Triangle*; as alſo in the Repreſentation and Solution of thoſe numerous *Nautical and Aſtronomical Problems* that ſo frequently occur at SEA in regard to the Aſpects, Diſtances, *&c.* of the SUN, MOON, and STARS, many of which are in themſelves very difficult to be underſtood, without having them properly formed on the GLOBE; many Caſes are very ambiguous in Speculation and Calculation, which are not in the leaſt ſo if conſtructed on the Surface of the GLOBE; and laſtly, how very tedious, perplexed, and haraſſing the Calculations of many practical Problems daily prove to the moſt ingenious Seaman, Experience ſufficiently teſtifies: All which Difficulties and Perplexities would in a great meaſure vaniſh by the proper Uſe and Aſſiſtance of ſuch a GLOBE and its *Apparatus*. Suppoſe he were to go one ſtep farther, and take upon him to beſtow upon this Globe the faſhionable *Epithet* of the LONGITUDE GLOBE, he does not know that he ſhould ſtand charged by Poſterity, *one Hundred Years* hence, with greater *Abſurdity*, *Vanity*, and *Preſumption*, than the Authors of the LONGITUDE SECTOR, the LONGITUDE CHAIR, or the LONGITUDE CLOCKS; all of which, in regard to public Utility, he would venture to propheſy, muſt at laſt yield to the ſuperior Advantage of ſuch a GLOBE, were it encouraged but with a Tenth Part of that Profuſion of public Treaſure, which has been ſo liberally beſtowed on many Projects of this Kind, though far leſs promiſing in their Nature than this.

But though it be the Fate of the moſt uſeful Things to be oftentimes overlooked and neglected, he is not without ſome Hopes that it will by degrees be more thought of and conſidered; eſpecially as he was firſt induced to think of ſuch a

Conſtruction of this large *Celeſtial* GLOBE by a Gentleman of well-known Skill in all Parts of *Nautical* ASTRONOMY, and at this time does no ſmall Honour to the *Britiſh* FLAG; and was himſelf pleaſed to order one to be made in ſuch a Manner, for his own Uſe at Sea.

Notwithſtanding the Judgment and Example of ſuch a Gentleman may be looked upon as an Argument *(inſtar omnium)* ſufficient to recommend and authorize the Uſe of this Conſtruction of the Globe at Sea, yet it will not be ſo neceſſary to inſiſt upon it in a Caſe where every ſkilful Mariner can't fail of being a competent Judge for himſelf. For knowing the Size of the Globe, he need not be told that a Degree of a great Circle is very near equal to ¼ of an Inch, and therefore by means of a (*Vernier* or) *Nonius*, ſuch a Degree is ſubdiviſible to ½ a Minute or 30″, nay to 20″ if required, therefore if proper Circles be applied about the *Poles* of the *Equator*, *Ecliptic*, and *Horizon*, and furniſhed with thoſe artificial Diviſions, he cannot but know that any *Spherical* Triangle may be almoſt inſtantly form'd, and the Meaſure of its Sides and Angles become known by Inſpection only to Half or a Third Part of a Minute, in moſt Caſes as great an Accuracy as can be to any Purpoſe required.

For ſince in order to form and ſtate any Caſe for *Nautical Calculations*, the Meaſures of the ſeveral Sides and Angles muſt be taken by Inſtruments much leſs perfect than this large GLOBE, it is evident the Globe is more than ſufficient for a Solution as accurate as the Condition of the Problem will admit. How vaguely is the *Ship's Way* eſtimated by the *Log-Line*? What Inaccuracy is the *Angle of the Courſe* ſubject to from the groſs Meaſures by the Points of the Compaſs? What great Perfection in the *Difference of Latitude*, the *Hour-Angle*, the *Altitude*, and other eſſential Parts of a CASE of SAILING, when determined even by *Hadley's Quadrant*, the moſt exact of all Sea Inſtruments? If the given Parts of a Triangle then are ſo indeterminate, why ſhould the Part ſought be required with ſo great Preciſion? 'Tis abſurd to expect it; and this Globe will find the Part required with twice the Exactneſs that the others can poſſibly have.

Even in the *Grand Problem* of finding the LONGITUDE by the *Diſtance of the Moon from the Sun or Star* meaſured by the OCTANT, the true Diſtance is by the GLOBE to be meaſured with as great Exactneſs as the apparent Diſtance from Obſervation can admit of. Where is then the neceſſity of puzzling the poor *Mariner* with blind, tedious, operoſe, and intricate RULES, derived from the darkeſt Receſſes of *Spherical Trigonometry*, to obtain an Accuracy of a *few Seconds* only?

To conclude, he thinks it is not to be doubted but that if this GLOBE with its Apparatus were uſed in Conjunction with Mr. CLAIRAUT's TABLES of the MOON, the DIFFERENCE of LONGITUDE would be attainable with much greater Eaſe than it is now, or ever will be, by any other Means whatſoever. In ſhort, where is the expert Mariner, who would not be immediately appriſed of the Light that would be thrown upon all his Operations in Nautical *Aſtronomy* by the Conſtruction of ſuch a Globe; and conſequently of the inviting Pleaſures of thoſe Studies, which do now appear rather diſcouraging from a dark and unintelligible Procedure?

INSTITUTIONS OF ASTRONOMICAL CALCULATIONS.

CHAP. I.

Of the Chronological PRINCIPLES *of* ASTRONOMY.

3761. IT is a very eaſy Matter to give Precepts for *Aſtronomical* CALCULATIONS; but unleſs the Reaſon of each particular Step, and conſequently the Rationale of the whole Proceſs, be laid open to the Reader, it can afford a Satisfaction of no higher Nature than that of being able to do a Thing, as it were, mechanically; and that alone can be attended with very little Pleaſure to the inquiſitive and ingenious Mind.

3762. To throw a Light, therefore, upon the following Computations, and Conſtruction of aſtronomical Tables, a few *Chronological Principles* muſt be premiſed, ſuch as reſult from thoſe Parts of Aſtronomy as we have already treated of in the ſeveral foregoing Parts of this Work. The firſt Buſineſs in CHRONOLOGY is to find out the beſt *Standard* MEASURE of TIME for civil and ſcientifical Uſes. And when every Thing has been conſidered in that Regard, nothing has been found to anſwer ſuch a Purpoſe, but the *Motions* and *periodical Revolutions* of the heavenly Bodies.

3763. Among theſe, the Motions of the Two great Luminaries, the SUN and MOON, were the only ones that could be appropriated to ſuch an Uſe; nor theſe neither, unleſs they were firſt properly qualified to anſwer ſuch Ends, *viz.* to become as adequate *Meaſures of Time* as the Nature of Things can admit of. *One Revolution* of the SUN *through the Zodiac* was called a YEAR; and One ſuch Revolution of the MOON was called a MONTH. And thus the Ancients became furniſhed with a Twofold Meaſure of Time.

3764. Beſides theſe Two larger Meaſures, they found it expedient to have one leſs; and here the *Diurnal Revolution of the Sun from the Meridian to the ſame again*, anſwered their Wiſhes in a better Manner than any thing elſe could be found to do; and this Meaſure of Time they called a DAY, or (in their own Tongue) *Nychthemeron*, including the *common Day and Night*.

3765. Their next Care was to find a proper Subdiviſion of theſe large Meaſures of Time; thus the YEAR was divided into *Months*; a MONTH into *Days*; DAYS into *Hours*, *Minutes*, *Seconds*, &c. as we have ſhewn at large in the Treatiſe of CLOCK-WORK.

3766. The Time which intervenes between the Sun's departing from the Equinoctial Point, or any Point of the Ecliptic, and returning to the ſame again, is called the *Tropical* YEAR, which in its mean Quantity is ſtated by ſeveral Aſtronomers as follows:

	D	H	′	″	‴
By FLAMSTEED and NEWTON	365	5	48	57	
HALLEY — —	365	5	48	54	30
CASSINI — —	365	5	48	52	
DE LA CAILLE —	365	5	48	49	
MAYER — —	365	5	48	51	12

3767. This is known by obſerving the Number of Revolutions, and Parts of one, which the Sun makes in any certain Number of Years. Thus the Place of the Sun was the laſt Day of *December* at Noon 1680, Old Stile,

	s	°	′	″
	9	20	34	46
And the ſame Moment, on the ſame Day 1700	9	20	43	50

Therefore the Revolutions made in the Time of 20 Years, are — — R 20 0 9 4

Then ſay, As 20 R 0° 9′ 4″ is to 7305 Days (or 20 Years) ſo is one Revolution (or 360°) to 365 D 5 H 48′ 57″ the Length of the *Tropical Year*, according to Sir ISAAC NEWTON.

3768. The *Sidereal* YEAR is the Time the Sun takes in departing from a Star (or any fixed Point in the Heavens) and returning to the ſame again; and this by Sir *Iſaac Newton*'s Computation is 365 D 6 H 9′ 14″ 30‴. The Difference between the *Tropical and Sidereal Year*, viz. 20′ 27″ 30‴ is owing to the Equinoctial Points not being fixed, but having a retrograde Motion in the Ecliptic at the Rate of 50″ or 51″ *per Annum*, as we have formerly obſerved (1922). This Motion of 50″ takes about 20′ ½ of Time, as appears in the following Tables.

3769. The *Lunar* MONTH is alſo twofold; *viz.* The *Periodical* MONTH, which is the Time the Moon takes in running through a complete Circle in the Heavens, or in departing from a fixed Point therein, and returning to the ſame again; this Space of Time, at a Mean, is in our Age 27 D 7 H 43′ 4″ 45‴, but in a long Courſe of Time this *Mean Month* is variable; for at the Time between *Hipparchus* and *Ptolemy* it was 27 D 7 H 43′ 5″ 3½‴, and therefore it decreaſes at the Rate of 1‴ 5⁗ 15^{v} in a Century.

3770. The other is called the *Synodical* MONTH; and is that Space of Time which intervenes between one New Moon and the next following; at the Beginning of this Century its mean Quantity was 29 D 12 H $44'\ 2''\ 53'''\ 23''''$. But at the Beginning of the Chriſtian Æra it was 29 D 12 H $44'$ $3''\ 15'''$, ſo that it decreaſes alſo by $1'''\ 16''''\ 16^{v}$, according to Mr. *Mayer*. The Reaſon of the Difference of theſe two Months is contained in Inſtitut. 3592, and the following.

3771. Before the Invention of the *Teleſcope*, and many other accurate aſtronomical Inſtruments, it was impoſſible for the Solar Years and Months to be determined to any conſiderable Degree of Exactneſs, and therefore we find the Antients applying the annual Meaſure of Time, or Year, in civil Life, in a very vague Manner. Thus *Romulus*, the firſt King of *Italy*, formed the Year originally of ten Months only; beginning with *March*; which Year, as it fell far ſhort of the Solar Year, was obſerved by his Succeſſor *Numa Pompilius*, who added two other Months, *viz.* *January* and *February*; and now the Year conſiſted of 12 Months.

3772. But the Months of this Year were *Lunar* Months, or 12 Lunations of 29½ Days each, which made this Civil Lunar Year to conſiſt of 354 Days. Which being ſtill ſhort of the *Solar Civil* Year of 365 Days, by 11 Days, theſe were afterwards added by *Julius Cæſar*.

3773. This Civil *Soli-Lunar* Year of 365 Days being deficient of the true *Solar* or *Tropical Year* by 5 H $48'\ 57''$ (3766) occaſioned the Beginning of the Year (in *March*) to go forwards through the Seaſons nearly *one Day* in four Years, as is evident, ſince 5 H $48'\ 57''$ wants but $11'\ 3''$ of 6 Hours or ¼ of a Day.

3774. This being obſerved, the ſame Emperor ordered that one Day ſhould be added to *February* every fourth Year, by cauſing the 24th of that Month to be reckoned *twice*; and becauſe the ſaid 24th of *February* was the 6th (called by the *Romans*, *Idus Sextilis)* before the Kalends (or firſt Day) of *March*, therefore this fourth Year was called the *Annus Biſſextilis*, and is our *Biſſextile* or *Leap Year*. And the Year, thus corrected, is called the *Julian* YEAR or *Julian* ACCOUNT.

3775. Becauſe the ſix Hours in four Years is too much by 11′ 3″ to equal the *Civil* with the *Aſtronomical* Year, therefore the Sun each Year muſt begin his Courſe 11′ 3″ before the *Julian Year* is ended; and this Quantity in 131 Years amounts to a *whole Day*, or in 1310 Years to 10 Days; therefore ſince the Equinox at the Time of the *Nicene* council *A. D.* 325, fell upon the 21ſt of *March*, it was found at the latter End of the 16th Century to happen on the 10th of the ſame Month, by this *conſtant Anticipation.*

3776. By this means EASTER, and all other feſtivals which depended upon it, inſtead of being *fixed* in the Calendar of the Church, were found to be groſly *erratic*, and to go backwards through all the Months of the Year if let alone. But an Error in Chronology was inſufferable, and therefore POPE *Gregory* XIII. reſolved to make a Reformation of the Kalendar, and accordingly ordered 10 Days to be taken out of the Month of *October* 1582, by calling the 5th Day the 15th. And to prevent the Regreſs of the Equinoxes for the future, ordered every 100th Year to conſiſt of 365 Days, whereas in the *Julian* Account it is a *Leap Year* of 366. The Calendar, thus rectified, has been ſince called the *Gregorian Account*, or *New Stile.*

3777. Since the *Council of Nice* to the Year 1752, 1427 Years have elapſed, and the Calendar was then rectified by the *Britiſh* SENATE, by ordering 11 Days to be left out of the Month of *Sept.* and cauſing the Civil Year to begin on the firſt of *January*. Theſe Things, together with ſome precautionary Intercalations to ſettle the Equinoxes in future, make that Emendation of the Calendar, which may be properly called the *Britiſh* ACCOUNT or *Georgian* STILE, as it was made in the Reign of GEORGE II.

3778. Enough has now been ſaid to explain the Nature, Conſtruction, and Rationale of the *Solar Tables* in the Form we receive them from Mr. MAYER, as they ſtand in the ſecond Volume of the COMMENTARIES of the ROYAL SOCIETY of *Gottingen*. Theſe Tables, the learned Author tells us, though they are nearly the ſame with others, were yet ſtrictly examined by him; and he took not a ſingle Element upon the Authority of other Aſtronomers, till he had verified it anew by his own Obſervations. Therefore all I have to do is, to make them *Engliſh*, and to ſhew their Uſes in Aſtronomical Computations relative to the Sun.

CHAP. II.

Of the NATURE, CONSTRUCTION, and USE of *Solar* TABLES, on PRINCIPLES derived from the THEORY of a PLANET'S MOTION.

TABLE I.

3779. THE Title of the *firſt Table* is, *A Table of the Mean Motions of the Sun in Julian Years*. By *Julian* Years is here meant ſuch as conſiſt of 365 Days in common, but every fourth Year of 366, agreeable to (3774). Againſt every ſuch fourth Year is placed the Letter B, to denote it to be a *Biſſextile* or Leap Year, and the Numbers correſponding thereto are very different from the reſt, by the additional Motion of one Day. How the Numbers in this Table are computed, will be eaſy to underſtand, when it is conſidered, that in 365 D 5 H 48′ 57″ the Sun makes one Revolution compleat, or runs through the 12 Signs of the Ecliptic; therefore in 365 Days it will paſs through 11 s 29° 45′ 40″, which will therefore be the Mean Motion for one *Julian Year*.

3780. Therefore the Motion for three Years of the Biſſextile Period will ariſe by a conſtant Addition of 11 s 29° 45′ 40″ to the Motion of the preceding Year; and the Number of the fourth Year, by the Addition of the ſame Quantity, increaſed by the Mean Motion of one Day, which is 59′ 8″, theſe together make 0 s 0° 44′ 48″.

	s	°	′	″
Then the Motion for the third Year is —	11	29	17	1
To which add — — —	0	0	44	48
The Sum is the Motion for Biſſ. Year —	0	0	1	49
To which again add — — —	11	29	45	40
The Sum is the Motion of the fifth Year	11	29	47	29

And thus you proceed for the reſt.

3781. It appears, that ſince four times 5 H 48′ 57″ is not quite a whole Day, therefore the additional Motion of a whole Day will be too much by 1′ 49″ (or in the Table 1′ 50″) to cauſe the Sun to *begin its Courſe exactly with the Beginning of the Year*, or on *December* 31ſt at Noon. Or thus, Suppoſe the Sun were to begin his Courſe from the Equinoctial Point on the 21ſt of *March* at Noon, it is plain that the Sun would not return to that Point till the next *March* 21 D 5 H 48′ 57″ in the Afternoon. Alſo that its ſecond Return to the *Equinox* would be *March* 21 D 11 H 37′ 54″ at Night. The third Return would be on *March* 21 D 17 H 26′ 51″, that is, on *March* 22 D 5 h 26′ 51″ in the Morning. And laſtly, its fourth Return to the Equinox would be on *March* 22 D 11 H 15′ 48″ in the Forenoon.

3782. Now ſince this fourth Return to the Equinox is 44′ 12″ *before Noon*, and the Addition of the Motion of a whole Day makes the Sun's Ingreſs *exactly at Noon*, it is evident the Time of the Equinox in the Heavens will *precede the Time* in the Calendar by 44′ 12″ in every Biſſextile Period of four Years. This *Preceſſion of the Equinoxes* will amount to a whole Day in about 130 Years, and therefore in order to keep the Equinoxes to the ſame Time in the Calendar, every 128th or 132d Year, which is a Biſſextile one, ſhould be a common Year of 365 Days only.

3783. In the *third Column* are the Numbers expreſſing the Mean Motion of the Sun's *Apogee*, which is at the Rate of 1′ 3″ *per Annum*; this is the ſame Point which we formerly called the *Aphelion* of the Earth (3658). Its Motion is determined by Obſervations at diſtant Intervals of Time. Thus, according to Sir I. Newton,

	s	°	′	″
Its Place in 1680 was in	3	7	23	30
And in 1700	3	7	44	30
Hence its Motion in 20 Years			21	0

which is 1′ 3″ *per Annum*, as in the Table.

3784. The *fourth Column* contains the Mean Motion of the *Equinoctial Points*; for theſe Points are not fixed, but have a ſlow retrograde Motion, which, though unequable in itſelf, is at a mean Rate of 50″ or 51″ *per Annum*, as we have obſerved at (1922).

TABLE II.

3785. The Title of this Table is, *The Epochas of the Mean Motions of the Sun* adjuſted to Mean Time, under the Meridian of the Obſervatory of *Paris*. By an *Epocha* is meant any ſtated or given Year in any Account of Time, for which the Sun's Place or that of the Apogee is required to be known. Thus in the firſt Column, and in the upper Part, you find the Centuries before the Birth of Chriſt to 600, and the ſame after that Æra below to 1580 in the *Julian Style*. Then begin the *Epochs* of the *Gregorian Style*, and are continued after 1736 to 1800 for every Year of that Account.

3786. In the *ſecond Column* of this Table the Place of the Sun is ſpecified for each reſpective Epocha or Year; and in the third Column that of the Apogee, under the Titles of *the Longitude of the Sun, and of the Apogee*, from the mean Place of the Vernal Equinox.

3787. As theſe Tables are adjuſted to Mean Time, under the Meridian of the *Obſervatory of Paris*, which by the niceſt Obſervations is found to be 9′ 15″ before the Time at the Meridian of the *Royal Obſervatory at Greenwich*; therefore when the Mean Time of any Phænomenon, or for any Calculation, is ſpecified or propoſed here, the ſaid 9′ 15″ muſt be added thereto, to rectify it for theſe Tables. And, on the contrary, when the Time is derived from theſe Tables, it muſt be diminiſhed by 9′ 15″ to expreſs the Time at the *Britiſh Obſervatory*, as it lies more *Weſt* than that at *Paris*. And 9′ 46″ muſt be added or ſubtracted for the Meridian of *London*, as this Metropolis is ſtill more Weſt from *Paris*.

3788. Since the Year 1752 the *Gregorian Account* of Time, commonly called the *New Stile*, has been uſed by us; and therefore we uſe theſe Tables without any further Trouble than the ſmall Rectification now mentioned. As to the Numbers of the Table, they ariſe by the conſtant Addition of the Motion of the Sun and its Apogee in one *Julian Year*, except in *Leap Year*, which requires the Motion of a Year and a Day, *viz.* 44′ 48″, to be aded according to (3780) for the Long. of the Sun from *the mean Equinox*.

TABLE III.

3789. The Title is, *A Table of the Mean Motions of the Sun for Months and Days*. The Months of the *Julian* Calendar are on the Top, and the Days by the Side of each Column, in which the Mean Motion of the Sun for each reſpective Day of the Month is contained throughout the Year, which Numbers ariſe from the conſtant Addition of the Mean Motion in one Day, *viz.* 59′ 8″. A ſmall Column of Seconds is annexed to each Month for the Mean Motion of the Apogee.

3790. At the Foot of the firſt Page of this Table is this Precept——*In the Months of January and February in a Biſſextile Year, let one Day be deducted* from the Time propoſed.

The Reaſon of which is evident from what we have ſaid (3774), becauſe ſince the Motion of a Day has been added to the *Leap Year*, and this Day is not put into the Calendar till the *End of February*, it is plain there is in each Leap Year the Motion of one Day too much in the two firſt Months, and therefore muſt be ſubducted, as preſcribed.

3791. As *January* has 31 Days, there was no Room for this intercalary Day till the End of *February*, where it makes the 29th, and thereby makes that the *firſt of March* which would otherwiſe have been the *ſecond*; and conſequently the 22d of *March* will by this means become the 21ſt, and the Equinox be thus kept to its proper *Numerical Day* of the Month of *March*, as required by (3776).

TABLE IV.

3792. This is a ſmall Table, whoſe Title declares its Uſe, *viz. A Table of the Mean Motion of the Sun for Hours and Minutes*; in which, as the Numbers are produced by the conſtant Addition of the Motion of one Hour, *viz.* 2′ 28″, there is no Explication required, unleſs it be this one Obſervation, that becauſe there is the ſame Number of Seconds in a Minute as of Minutes in an Hour, (*viz.* 60), therefore the Number 2″ 28‴ of *Seconds* and *Thirds* for one Minute will be the ſame as for *Minutes* and *Seconds* in one Hour; and the ſame 2‴ 28⁗ likewiſe for *Thirds* and *Fourths* for the Motion in one Second. Hence the Reaſon of the *threefold Notation* at the Top of the Table.

TABLE V.

3793. This is *A Table of the Apparent Diameter and Hourly Motion of the Sun, whoſe Argument is the Sun's Mean Anomaly.* By the Word *Argument* is meant *the Rule* by which the variable Apparent Diameter and Horary Motion of the Sun is eſtimated, and which, in both theſe Caſes, is the Mean *Anomaly of the Sun.*

3794.

3794. For we have ſhewn in the THEORY of a PLANET's Motion, that the Orbit A D P E, which it deſcribes about the central Body S, is an *Ellipſis* (1230) and S the lower *Focus* thereof. Then if about the longer Axis A P a Circle be deſcribed upon the Center C of the Ellipſis, and divided into 12 equal Parts, beginning from the Point A, theſe will repreſent the 12 Signs of *Mean Anomaly*; we have alſo ſhewn (3670, &c.) that by *Mean Anomaly* is meant its Motion from the higher Apſis A meaſured by the Angle A F L (ſuppoſing the Planet at L) and the *true* or *equated Anamoly* is the Angle A S L; and the Difference S L F is the Equation of the Orbit (See Fig. 1.)

3795. Now it is evident when the mean Anomaly is = 0, the Sun is at A in its greateſt Diſtance from the Earth at E, and conſequently its *apparent Diameter* will be there leaſt of all, *viz.* 31′ 34″, according to Mr. *Mayer*'s Obſervations, as appears by his Table. In like Manner when the Sun has ſix Signs of Mean Anomaly, or is at the lower Apſis P, it is then neareſt the Earth; and its Apparent Diameter is, of courſe, largeſt, *viz.* 32′ 38″, as in the Table. So that from 0 to 6 Signs of Mean Anomaly it increaſes, and from 6 s to 12 s it decreaſes.

3796. In like Manner when the Sun is at A, his Motion is ſloweſt, as being there fartheſt removed from the Center of Force S, ſo that when the Mean Anomaly is = 0, its Motion is but 2′ 23″ *per* Hour by Obſervation, as appears in the Table; but when the Mean Anomaly is 6 Signs, the ſaid Hourly Motion is 2′ 33′; whereas the Mean Anomaly being 3s or 9s, the Hourly Motion is of a Mean Quantity, *viz.* 2′ 28″, as in ſtated the preceding Table.

TABLE VI.

3797. This Table contains *The Equation of the Sun's Center*; *and its Argument is the Sun's Mean Anomaly* as before. This *Equation of the Center* is the Angle S L F, as we juſt now obſerved (3794); and as it is the Difference between the *Mean and True Anomaly*, it is plain that if one of theſe be given, the other will be found, by adding or ſubtracting this Equation to or from the given one.

3798. It is further evident, that the *Mean Anomaly* is the *Argument* of this Equation, becauſe when the Sun is at A, this Angle or Equation is nothing, as you ſee in the Table; then as the Mean Anomaly increaſes, till it becomes three Signs, ſo that the Equation increaſes till it becomes 1° 55′ 30″. After this the Mean Anomaly continuing to increaſe till it comes to be ſix Signs, or the Sun is in its *Perigee* at P, the Equation or Angle F L S will decreaſe till it becomes nothing in the ſaid Perigee. From this lower Apſis the Sun aſcends, and the Angle or Equation again increaſes till it comes to its *Maximum*, when the Anomaly is nearly 9 Signs. And as from thence it increaſes to 12 Signs, the Equation decreaſes to nothing in the higher Apſis A. And accordingly you ſee the Numbers expreſſing this Equation increaſe and decreaſe in the Tables.

TABLE VII.

3799. This Table contains the *Diſtance of the Sun from the Earth* for every Degree of Mean Anomaly, which Diſtance is the Line S L in the Figure. Aſtronomers divide the mean Diſtance A C into 100000 equal Parts; then it is found by Obſervations that the *Eccentricity* C F = C S, in the Earth's Ellipſis, is 1680 of thoſe Parts; and hence the greateſt Diſtance of the Sun S A will contain 101680, and the leaſt Diſtance S P = 98320, as in the Table appears.

Therefore the *Argument* for the Numbers of this Table muſt be the *Mean Anomaly* of the Sun, becauſe theſe Numbers decreaſe from the Aphelion A to the Perihelion P, and from thence increaſe again.

3800. In the oblique Triangle S L F, the Sum of the two Sides, S L + L F = A P = 200000; the other Side S F = 3360 the double Eccentricity; the Angle S F L is the Complement of the Mean Anomaly A F L; the Angle L S F is the *True Anomaly*; and the Angle S L F the Equation of the Earth's Orbit, or Center; conſequently this Triangle is a capital Element in Aſtronomy, and rendered of general Uſe by means of this Table. But barely in regard to calculating the Sun's Place, this Table is of no Uſe.

N. B. The Reaſon of the Corrections contained in Tables VIII. and IX. will be taken Notice of after the Theory of the Moon is premiſed, as they proceed from perturbating Forces like thoſe which produce the Lunar Irregularities.

CHAP. III.

The THEORY of the MOON'S MOTION explained from *phyſical* CAUSES, *viz.* the POWERS of GRAVITY acting upon the SUN, EARTH, and MOON mutually, and in the Ratio of the *Square of the Diſtances inverſely.*

3801. IF the Moon, in its Motion about the Earth, was affected with no other Centripetal Force but that of the Earth alone, ſhe might deſcribe an Ellipſis about the Earth in one of its Foci, in the ſame Manner as the Earth deſcribes one about the Sun; the Times of her Revolutions would be all equal; the Places of the Apogee, Node, and the Inclination of the Orbit would be conſtantly the ſame; and the *Lunar Tables* would be of the ſame Form as the *Solar ones* already deſcribed, and the ſame in Number nearly.

3802. But becauſe the Moon is affected not only by the Earth's Gravity, but at the ſame time by the Gravity of the Sun; and theſe Two Forces being directed to different Points or Centers, will produce a Variety of Irregularities or Inequalities in the Moon's Motion, and render many Tables of Equations neceſſary for aſcertaining her Place, as alſo that of her Apogee, Node, *&c.* for any given Time, with the Quantity of the Inclination of her Orbit, Latitude, Eccentricity, Apparent Diameter, Parallax, *&c.*

3803. To make this intricate Doctrine plain, we ſhall here conſider the Action and Effects of theſe Forces in the moſt ſimple Caſes, *viz.* ſuch as the Moon deſcribing a circular Orbit about the Earth in its Center, which Orbit is alſo in the Plane of the Ecliptic or Earth's Orbit; and this Orbit of the Earth muſt be alſo ſuppoſed a Circle in whoſe Center is the Sun. Theſe Things premiſed, let S be the Sun, T the Earth, P the Moon, in its circular Orbit A D B C; and draw S T, S P (Fig. 2.)

3804. Then ſince the Force of Gravity in the Earth T, and Moon P, towards the Sun S, are as $\frac{1}{ST^2}$ and $\frac{1}{SP^2}$ (986) therefore in the Line S P (continued out) take S L to S T (or S K) as SK^2 (or ST^2) SP^2; and the Lines S K and S L will repreſent the attracting Forces at the Earth T and Moon P. Parallel to P T draw L M, cutting the Line S T (produced if there be Occaſion). Then is the Force (at the Moon) S L reſolved into Two others L M and S M; of which the firſt L M conſpires with P T the Direction of the Moon's Gravity to the Earth, and is therefore *an additional Force to the Moon's Gravity towards the Earth in the Point* P.

3805. The Second Part L M is the Sum of the Earth's Gravity T S to the Sun, and the additional Part T M of the Sun's Force S M, which acts upon the Moon P in a Direction paralled to S T, and produces two very conſiderable Effects, which may be thus explained.

3806. From P draw the Line P *q* equal to T M and parallel to T S, and from *q* let fall a Perpendicular *q r* upon T P produced; then will the Force P *q* (or T M) be reſolved into the two Forces *q r* and *r* P; the firſt of theſe is parallel to the Tangent *a b* at the Point P, and therefore is *that Part of the Solar Force by which the Moon is accelerated in her Orbit from* P *towards* A.

3807. The ſecond Part rP being in the Direction of the Earth's Attraction PT, and acting contrary thereto, is *that Part of the Sun's Force by which the Earth's Attraction upon the Moon is diminiſhed at the Point* P.

3808. In the oppoſite Quarter ſuppoſe the Moon at p, and, drawing Sp, take $Sl : Sk :: Sk^2 : Sp^2$; and draw ml parallel to Tp; laſtly make $ps = Tm$, and reſolve it into the two Forces pt and st. Then here alſo the Force ml increaſes the Moon's Gravity to the Earth, and the Force pt leſſens it; the Force ts accelerates the Moon's Motion from p towards B.

3809. If a like Conſtruction be made in the other two Quarters AD and BC; it will appear that in them the Sun's Force upon the Moon *will in part increaſe and in part diminiſh its Gravity towards the Earth*; while the third Part, acting contrary to the Direction of the Moon's Motion in her Orbit, *will retard that Motion in both Quarters* (Fig. 2.).

3810. Hence it appears that the Motion of the Moon is accelerated and retarded alternately in each Quarter; which Phænomenon was firſt obſerved by the famous *Tycho Brahe*, and was by him called the VARIATION. This unequable Motion of the Moon will not admit of *equal Angles being deſcribed in equal Times*, as would be the Caſe by an *equal Motion in a Circle.*

3811. For now we can no longer conſider the Moon's Orbit of a *circular Form*; becauſe in and near the Syzigies A and B the accelerated Motion will carry her through a larger Arch in the ſame Time than what ſhe deſcribes in the Quadratures C and D with her mean Velocity. Beſides, the abſolute Gravity of the Moon to the Earth being leſs in A and B than it is in C and D, the Moon will be leſs deflected from a right lined Path, the leſs it is attracted towards T.

3812. Hence the Moon in C and D recedes farther from the Earth T than at the Points A and B, where the Orbit is leſs curved. And the Form of the Orbit is an *Oval*, with the Earth in its Center, as repreſented in Fig. 4. For, as we have ſhewn, it cannot be a *Circle*; nor can it be an Ellipſis, becauſe the Parts of the Solar Force L M and S M have neither the Ratio nor the Direction neceſſary for that Purpoſe.

3813. For with reſpect to the firſt L M, though it be directed to the Center T, it is not inverſely as TP^2, but directly and ſimply as P T; for by ſimilar Triangles S P T, S P M, we have $SP : PT :: SL : LM$, therefore $LM = \frac{PT \times SL}{SP}$, but S L is as $\frac{1}{SP^2}$ (3804) therefore L M is as $\frac{PT}{SP^3}$; and lm as $\frac{pT}{Sp^3}$; that is $LM : lm :: PT : pT$; and therefore the Earth's Force $\frac{1}{PT^2}$ compounded with the Force L M makes a Force as $PT + \frac{1}{PT^2}$, by which no *Conic Section* can be deſcribed (1230).

3814. Then as to the Force S M, it will cauſe the Lunar Orbit to vary from an Ellipſis on a double Account: firſt, as it does not act in the Direction P T; and ſecondly, becauſe it is not inverſely, as PT^2, which is thus ſhewn. By ſimilar Triangles we have $PT : ST :: LM : SM$, therefore $SM = \frac{ST \times LM}{PT}$, but $LM : \frac{PT}{SP^3}$, therefore $SM = \frac{ST}{SP^3}$, or becauſe S T is conſtant, it will be $SM : \frac{1}{SP^3}$.

3815. It is evident, when the Moon P is at C or D (in the Quadratures) the Line P L or T M vaniſhes, and L M is coincident with C T, and equal to it. And becauſe of the immenſe Diſtance of the Sun S, the Lines S L and S M may be deemed parallel, and ſo every-where we have $LM = PT$, and $PL = TM$; and, without any ſenſible Error, we ſuppoſe $SP = SK$.

3816. Now in the Syzigies A and B the Force L M is directly oppoſed to the Force T M or P L, and becauſe in that Caſe it is equal to $AT = PK$; therefore $PL - PK = KL$, will then be the whole Force by which the Centripetal Force of the Earth upon the Moon will be diminiſhed by the Action of the Sun; hence the general Ratio of K L to T M remains to be ſtated.

3817. Becauſe by the Conſtruction $SL : SK :: SK^2 : SP^2$; therefore $SL - SK : SK :: SK^2 - SP^2 : SP^2$, but $SL - SK = KL$, and $SK^2 = SP^2 + 2SP \times PK + PK^2$; therefore $KL : SK :: 2SP \times PK + PK^2 : SP^2$; and laſtly, becauſe $SK = SP + PK$, therefore by the laſt Analogy we have $KL = 2PK + \frac{3PK^2}{SP} + \frac{PK^3}{SP^2}$: but the two laſt Terms may be neglected as of no Value, ſo that $KL = 2PK$, and $PL = TM = 3PK$.

3818. Conſequently in the Conjunction A, and Oppoſition B, we have $TM = 2TA$; *whence it appears that the Diminution of the Earth's Gravity by the Action of the Sun is then twice as much as the Increaſe thereof in the Quadratures.* So that upon the Whole ſince K L is greater than L M, the Gravity of the Moon to the Earth is more diminiſhed than increaſed by the Sun's Action.

3819. Let P be the Moon's Periodical Time, and $PT = a$, and let F = Earth's Centripetal Force; then we have $F : \frac{a}{P^2}$ (1176). So that when (a) is conſtant, the *Period of the Moon's Revolution will be increaſed in the ſubduplicate Ratio of that by which the Force* F *is diminiſhed*; *for then* $P : \frac{1}{\sqrt{F}}$.

3820. Alſo ſuppoſing P T or (a) variable, then in every Caſe we have $P^2 : a^3$ (1181) or $P : a^{\frac{3}{2}}$; whence if (a) and F be both variable, it will be $P : a^{\frac{3}{2}} \times F^{-\frac{1}{2}}$, that is, *the Periodical Time will be in the ſeſquiplicate Ratio of the Diſtance* P T, *compounded with the inverſe ſubduplicate Ratio of the Central Force* F.

3821. Since the Force T M begins at the Quadrature and increaſes to the Syzygy, where it is equal to 2 P T, there will be a Point between, where that Part of it which acts directly againſt the Central Force F will be equal to the Force L M, that is, where $Pr = PT$; and, conſequenty, *where the Central Force* F *is neither increaſed nor diminiſhed by the Action of the Sun upon the Moon.*

3822. To determine this Point P we have in the ſimilar Triangles K P T, and Prq, this Analogy $PT : PK :: Pq$ $(= 3PK) : Pr = PT$. Whence $3\,PK^2 = PT^2$; and conſequently $PT : PK :: \sqrt{3} : 1 ::$ Radius P T : Sine P K of the Arch $CP = 35° \; 16'$; whence the Arch $PA = 54° \; 44'$.

3823. To determine the Point P or Angle P T A, where the Force rq, which accelerates or retards the Motion of the Moon, is greateſt of all, let P K be produced to I, and draw I T (Fig. 3.) alſo from I let fall the Perpendicular I G upon P T continued out; and becauſe Iq is parallel to A B, and rq to I G, we have $rq : IG :: Pq : IP :: 3PK : 2PK ::$ $3 : 2$. Therefore $rq = \frac{3}{2}\,IG$; ſo that when rq is a *Maximum*, I G is equal to Radius; but it is always the Sine of twice the Angle K P T or P T A (for $ITG = KPT + KIT = 2\,PTA$) therefore the Angle $PTA = 45°$, or the Arch P A or P C, an Octant of a Circle.

3824. Laſtly, becauſe $PT : PK :: Pq : Pr :: 3PK : Pr$, therefore $Pr = \frac{3\,PK^2}{PT}$; and ſo $PT - Pr = PT - \frac{3PK^2}{PT}$, which is the Expreſſion for the Part of the Sun's Force by which the Central Force between the Earth and Moon is at any Time affected. This is a *Maximum* when P K is nothing, or the Moon P in the Quadratures C & D; and when $PT - Pr = 0$, or $PT = Pr$, the Arch $AP = 54° \; 44'$, as ſhewn before (3822).

3825. Thus it appears that by reaſon of the perturbating

Force of the Sun, the Moon could not deſcribe a *Circular Orbit* about the Earth, but an *Oval one*; and Sir *I. Newton* has ſhewn that her Diſtance from the Earth in the Syzygies is to that in the Quadratures as 69 to 70, in round Numbers.

SCHOLIUM.

3826. The ſame perturbating Forces may be conſidered as influencing the Motion of the Earth, and producing ſome Irregularities therein; the Sun's Force is indeed too ſmall to be ſenſible from ſuch immenſe Diſtance; thoſe of the Moon, *Venus*, and *Jupiter*, were they all to conſpire, would accelerate or retard the Earth's Velocity about 40 Seconds; but as in general they act contrarily, their joint Effect is but ſmall and inconſiderable. However, as Mr. *Mayer* has given (in Table VIII.) a Correction of the Sun's Longitude and Diſtance from the Earth, depending on the Moon's angular Diſtance from the Sun, we have here inſerted it. As alſo, Table IX. for equating the Mean Place of the *Vernal Equinox*, and *Obliquity* of the Ecliptic, both depending on the *Longitude of the Moon's Node*. For the Rationale of all which, ſee Appendix I. Vol. III. of *Philoſophia Britannica*, 2d Edit.

CHAP. IV.

Of the Nature of the EQUATIONS or *Corrections* of the Mean PLACE of the MOON, her NODES, INCLINATION of her ORBIT, and *Horizontal* PARALLAX, as deduced from Mr. CLAIRAUT'S New THEORY of the MOON.

3827. HAVING premiſed the Phyſical Principles of the Lunar Motions and Inequalities thereof, we ſhall next ſhew, that from them *Analytical Computations* have been made of the Motion and Place of the Moon, her Apogee, and Node; as alſo of the Quantity of the Inclination of the Lunar Orbit and Horizontal Parallax; and thus by having the Mean Place in Tables derived from Obſervations, we are, by theſe Calculations, enabled to find the Corrections or Equations, which, being properly applied, will give the true Place, *&c.* of the Moon for any given Inſtant of Time.

3828. By going thus directly to work in the Way of Analytical Inveſtigation, the Lunar Tables of Equations have received quite a new Form from thoſe which have been publiſhed hitherto, and deduced from Hypotheſes of Motions in *Cycles*, *Epicycles*, *Eccentrics*, &c. by *Ptolemy*, *Tycho Brahe*, *Kepler*, *Ricciolus*, *N. Mercator*, and many others; by which artificial Syſtems, the Tables fell ſhort both in Elegance, Perfection, and Perſpicuity, of thoſe which are derived from the Natural Theory. And, indeed, it would have been in vain to have endeavoured at an Explanation or Rationale of the former; whereas in the latter, it is a natural Conſequence of their Conſtruction, and, of courſe, is ſelf-evident.

3829. The Affair, in its firſt Principles, is alſo very ſimple, being compriſed in this *ſingle Problem*, viz. *To find the Equation of a Curve which a Body will deſcribe, projected with any Velocity and in any Direction; and alſo acted upon by two Forces at the ſame time, the one tending to a Center, and the other in a Direction perpendicular thereto.* It is plain the Caſe of the Body in this Problem is ſimilar to that of the Moon, which is to be conſidered as a Projectile, and is acted upon by a Centripetal Force tending to the Center of the Earth, and another acting at right Angles thereto (1170).

3830. In the Solution of this Problem they conſider the Central Force as compoſed of two Parts, one of which is inverſely, as the Square of the Diſtance of the Center of Force, and the other as an additional ſmall Force; juſt as we have found a Force reſulting from the Action of the Sun increaſing the Moon's Gravity to the Earth, and diſturbing the Moon's Motion (3824).

3831. As this Problem is the moſt noble of all in the *Phyſico Matheſis*, ſo its Solution is the moſt comprehenſive, prolix, and arduous of all others; and can be the Taſk only of the greateſt Maſters in the Analytic Art. Among theſe the late Mr. CLAIRAUT ſtands foremoſt, and his Work, juſt now publiſhed, intituled, THEORIE *de la* LUNE, *déduite du ſeul* PRINCIPE *de l'*ATTRACTION *réciproquement proportionelle aux Quarrés de Diſtances*, will eternize his Name; of which Performance it may be truly ſaid, *Hic Labor, hoc Opus eſt!*

3832. What renders this Theory of Mr. CLAIRAUT of the higheſt Eſtimation is, that it is the only Analytical Demonſtration that the Lunar Theory, founded on the common received Law of Attraction, is in every Part extremely agreeable to all the Obſervations that have been made, and thereby puts an End to all future Doubts and Controverſies on this Head; and fixes the *Newtonian* Philoſophy on the moſt ſtable Foundation of demonſtrated Truth.

3833. For with regard to the Motion of the Moon's *Apſides*, there has been a wide Difference between other Theories and Obſervations; inſomuch that by Sir ISAAC's own Theory that Motion is not quite half what it is obſerved to be. Mr. MACHIN (in his LAWS of the MOON's MOTION according to GRAVITY) roundly aſſerts—That he has never met with any Method, upon the commonly received Principles, that is perfectly ſufficient to explain the Motion of the Moon's Apogee. The Theory of Mr. D'ALEMBERT gives this Motion ſcarce half what it really is (See *Mem. de l'Acad. Royale des Sciences*, 1745). The Theory which gives it neareſt the Truth of any we have ſeen, is one in the Commentaries on the 3d Book of the *Principia*, where it comes out near 45° *per Annum*, but it is at a Mean only $40^{\circ}\ 40'\ 40''\frac{1}{2}$. Even Mr. *Clairaut* himſelf was not, for ſome Years, appriſed of the Perfection of his own Theory, ſtrongly maintaining that the Motion of the Apogee could not be accounted for on the common Principles of gravitating Forces.

3834. But the more he contemplated his Theory, the more he became ſenſible of his Error, and he has now publiſhed it for the thorough Conviction of all Mankind. We are now ſenſible that the *Lunar Theory* is the proper Subject of an *Analytical and Fluxionary Calculus*; and all its minute Varieties determinable thereby. The general Rationale thereof is likewiſe evident from the Nature of the Proceſs, and the Conſtruction of the *Lunar Tables*, and their ſeveral *Arguments*, at once appear from the Manner of forming the ſeveral *Equations* which produce them.

3835. The Reſults of his Theory (with reſpect to the ſeveral Articles neceſſary in Calculation) are what we can at preſent only treat of; and they are (1) The Equations for the *Moon's Place* in her Orbit and in the Ecliptic. (2) Thoſe of the NODE. (3) Thoſe which expreſs the Inclination of *her Orbit*. And (4) Thoſe for the *Horizontal Parallax*.

3836. In theſe Equations Mr. CLAIRAUT makes uſe of the following Symbols; *viz.*

1. $x =$ Mean Longitude of the Moon.
2. $y =$ M. Long. ☾ — M. Long. of the Moon's Apogee.
3. $z =$ Mean Long. ☉ — Long. of the Sun's Apogee.
4. $t =$ Mean Long ☾ — Mean Long. of ☉.
5. $s =$ Mean Long. ☾ — Mean Long. of Node ☊.

3837. As theſe Quantities, x, y, z, t, and s, are real Angles, or Arches of Circles, the Sines and Coſines of their Sums and Differences are the Terms of theſe Equations, affected with Co-efficients, which are alſo ſmall Parts of a Circle, and therefore expreſſed in *Degrees*, *Minutes*, and *Seconds*; and therefore the Signs of theſe Co-efficients multiplied into the Sines of the Angles to which they are affixed, will give the Value of the ſeveral Terms which expreſs the very complex Equations of the Moon's Longitude, Latitude, Parallax, *&c.*

3838. By putting S for the Sine of the ſeveral Angles, we have the true Place of the Moon in her Orbit expreſſed in the following Series of Analytical Terms:

$$
\begin{aligned}
&x - 6^\circ : 17' : 21'' \,\mathrm{S}.\, y - 1^\circ : 6' : 18'',3 \,\mathrm{S}.\overline{2t - y} - 1' : 58'',3 \,\mathrm{S}.\, t \\
&+ \text{- -}\ 12 : 56{,}8 \,\mathrm{S}.\, 2y + 33{,}2 \,\mathrm{S}.\, 4t - 2y + 39 : 31{,}4 \,\mathrm{S}.\, 2t \\
&\quad - \text{- -}\ 37{,}1 \,\mathrm{S}\, 3y + 27 \,\mathrm{S}\, 4t \\
&+ 11' : 25'' \,\mathrm{S}.\, z - 0' : 59'',9 \,\mathrm{S}.\overline{2s - 2t} - 0 : 23,''1 \,\mathrm{S}.\overline{y - t} \\
&\qquad - 3 : 18',8 \,\overline{\mathrm{S}\, 2y - 2t} \\
&+ 3' : 18'',3 \,\mathrm{S}.\overline{2t - - y - z} - 2' : 40'',5 \,\mathrm{S}.\overline{2t - z} - 3' : 17'',8 \,\mathrm{S}\overline{2t + y} \\
&+ 2' : 23{,}7 \,\mathrm{S}.\overline{y - z} - 1' : 48'',2 \,\mathrm{S}.\overline{y + z} - 1' : 8,''1 \,\mathrm{S}\overline{4t - y} \\
&+ 1' : 27'',8 \,\mathrm{S}.\overline{2s - y} + 6'',1 \,\mathrm{S}.\overline{t + y} - 26'',8 \,\mathrm{S}.\overline{2t - y + z} \\
&\qquad - 18{,}2 \,\mathrm{S}.\overline{2t + 2y} \\
&+ 22'',8 \,\mathrm{S}.\overline{2t + z} + 20'',3 \,\mathrm{S}.\overline{2t - z + y} + 11'',8 \,\mathrm{S}.\overline{2y - 2t + z} \\
&- 11'' \,\mathrm{S}.\overline{2y - z} + 17'',9 \,\mathrm{S}.\overline{3y - 2t}.
\end{aligned}
$$

3839. By this Expreſſion of the Place of the Moon, which conſiſts of no leſs than 20 Terms, the Reader will ſee to what a prodigious Degree of Exactneſs the Lunar Theory may be carried, provided proper *Data* could be obtained by Obſervations. Theſe are (1) The Mean *Eccentricity of the Moon's Orbit*, which is here ſtated 0,054673. (2) The *Eccentricity of the Solar Orbit*, which is here made 0,01683. (3) The *Ratio of the Mean Motion of the Sun to that of the Moon*, which is that of 0,0748011 to 1. (4) The *Parallax of the Sun*, which is here ſuppoſed to be 10,4″. By theſe given Quantities the Co-efficients of the ſeveral Terms in the above Expreſſion were determined.

3840. Mr. *Clairaut* has likewiſe determined the Expreſſion of the *Place of the Node*, and the *Inclination* of the *Moon's Orbit*, in 15 Terms each, which differ in the Co-efficients, but the Arguments, or literal Angles, are the ſame in each;

and by a moſt ingenious and dextrous Management, he has found, that two Terms only (out of the 15) are ſufficient to aſcertain the true Place of the Node, *viz.* $-\,2' : 3''\ \mathrm{S}.\,y + 10' : 23''\ \mathrm{S}.\,z$.

3841. In this new Method of conſtructing Lunar Tables, there is no Occaſion for thoſe of the Inclination of the Orbit, Place of the Apogee, Eccentricity, and ſome others found in the common Collections, as the Latitude of the Moon is directly calculated from the Theory, in a general Table; and then corrected by the following Equations (putting $l =$ Argument of Latitude, and $k = 2s - 2t$); *viz.*

$$
\begin{aligned}
&+ 8' : 46''\ \mathrm{S}.\overline{l-k} - 10'',1\ \mathrm{S}.\overline{l-y} + 17'',2\ \mathrm{S}.\overline{l-k-y}\\
&\qquad - 21,8\ \mathrm{S}.\overline{l-2y} + 9,5\ \mathrm{S}.\overline{l-k+y}\\
&\qquad + 2,6\ \mathrm{S}\overline{l-3y} - 1,7\ \mathrm{S}.\overline{l-k-2y}\\
&\qquad - 4,2\ \mathrm{S}\ \overline{l+y}
\end{aligned}
$$

$$
\begin{aligned}
&- 23'',4\ \mathrm{S}.\overline{l-k=z}\\
&+ 10,5\ \mathrm{S}.\overline{l-k+z}\\
&- 4.\ \mathrm{S}.\overline{l-k+2z}
\end{aligned}
$$

3842. The *Horizontal Parallax* of the *Moon* for the Latitude of PARIS (the ſame alſo for LONDON) reſults from this Theory in the following Expreſſion (putting $c\mathrm{S}=$Coſine) *viz.*

$$
\begin{aligned}
&57' : 3'' - 3' : 5'',3\,c\mathrm{S}.\,y - 34''\ c\mathrm{S}.\overline{2t-y} + 28'',1\ c\mathrm{S}.\,2t\\
&\qquad + 0 : 10,3\,c\mathrm{S}.\,2y + 0,4\,c\mathrm{S}.\overline{4t-2y} + 0,3\,c\mathrm{S}.\,4t\\
&\qquad - 0 : 0,6\,c\mathrm{S}.\,3y
\end{aligned}
$$

$$
\begin{aligned}
&- 3''\ c\mathrm{S}.\overline{2t+y} + 1'',6\,c\mathrm{S}.\overline{2t-y-z} - 1'',7\ c\mathrm{S}.\overline{2t-z}\\
&+ 1'',2\ c\mathrm{S}.\overline{y-z} - 0''9\ c\mathrm{S}.\,\overline{y+z} - 0'',7\,c\mathrm{S}.\overline{4t-y}.
\end{aligned}
$$

3843. Beſides Mr. MAYER, I know of no Author who has framed Tables on the Reſult of a direct analytical Inveſtigation of the Moon's Place, before theſe of Mr. CLAIRAUT. MAYER's Equations were deduced from an analytical Inveſtigation of the celebrated Mr. EULER, by a particular Method which he has not deſcribed. And though his Tables exceed all before in the Number of Lunar Equations and Corrections, yet he has but 13 of the 20 here calculated from Mr. CLAIRAUT's Theory.

3844. Mr. CLAIRAUT has diſtinguiſhed his Equations into *two claſſes*; the *firſt Claſs* contains the firſt five Equations or Terms, which he calls large ones (though the two laſt of theſe are but ſmall); their Arguments he denotes in his Tables by the *Capital Letters* A, B, C, D, E; and has given their Values in Signs, Degrees, Minutes, and Seconds.

3845. The *ſecond Claſs* contains the 15 following Equations or Terms of the General Expreſſion of the Moon's Place. The Arguments of theſe ſmall Equations he denotes by ſmall letters, *a*, *b*, *c*, *d*, &c. in their reſpective Tables. And their Values are expreſſed, for the ſeveral Epochas, in *Milleſſimal Parts* of the Radius, like natural Sines and Tangents.

3846. As theſe 20 Terms conſtitute 20 ſeveral Tables for correcting the Moon's Place in her Orbit, it may not be improper to give a diſtinct View of their Arguments, and of their Signatures; as alſo to point out thoſe which Mr. MAYER has made uſe of in his Collection, and the Order in which he has arranged them, which is quite different and almoſt contrary to that of Mr. CLAIRAUT.

1.	y - -	A	—	11 of *Mayer*,
2.	$2t-y$ -	B	—	12
3.	t - -	C	—	13
4.	z - -	D	—	1
5.	$2s-2t$ -	E	—	9
6.	$y-t$ -	a	—	10
7.	$2t-y-z$ -	b	—	5
8.	$2t-z$ -	c	—	3
9.	$2t+y$ -	d	—	6
10.	$y-z$ -	e	—	8

11.	$y+z$	f	
12.	$4t-y$	g	
13.	$2s-y$	h	— 7
14.	$t+y$	i	
15.	$2t-y+z$	k	— 4
16.	$2t+z$	l	— 2
17.	$2t-z+y$	m	
18.	$2y-2t+z$	n	
19.	$2y-z$	o	
20.	$3y-2t$	p	

3847. It is now eaſy to obſerve that all theſe Arguments are compoſed of four particular Quantities only; *viz.* (1.) The largeſt of all conſiſts ſimply of the *Moon's Mean Anomaly* $A = y$. (2.) The *Sun's Mean Anomaly*, $D = z$. (3.) The Diſtance of the two Luminaries $C = t$. And (4.) The Diſtance of the Moon from the Node $= s$. And from the *Sums*, *Differences*, and various Combinations of theſe, all the Arguments reſult, of which there are but three *ſimple ones*, viz. the 1ſt, 3d, and 4th.

3848. From a proper View of the Arguments, the Nature of the Equations will in general appear. For the *Moon's Anomaly* is evidently the moſt governing Principle, as that Member of the general Expreſſion where this Quantity alone enters, is many Times larger than all the reſt put together. And it ſo far influences all the Expreſſion, that there are but five Terms out of the 20, but where it actually enters, and has a greater or leſs Share in the Correction.

3849. The *Sun's Mean Anomaly* z not only conſtitutes a ſmall Equation of itſelf (D), but it alſo enters into the Compoſition of eight others, which ſhews in how general a Manner the Motion of the Moon is affected by ſo ſmall an Element as the *Eccentricity* of the Solar Orbit.

3850. Again, As we have ſhewn in the Phyſical Theory, the diſturbing Forces from the Sun depend greatly on the *Aſpect* of the *two Luminaries*, or their Difference of Longitude in the Ecliptic, denoted in theſe Equations by *t*, inſomuch that it conſtitutes one Equation wholly, *viz.* the *Variation* C; and is concerned in 13 others, ſingly or in Multiples; but moſt often 2*t* (as in 10 out of the 14) the Reaſon of which will appear more fully in the next Chapter.

CHAP. V.

Of the METHOD of calculating the QUANTITY of theſe EQUATIONS, and of conſtructing TABLES of the ſame.

3851. AS the foregoing Expreſſion of the Moon's Place in its Orbit (3838) conſiſts of the Mean Place (*x*) and 20 other Terms by which it is to be corrected, it is evident, theſe Terms will, when reduced to Numbers, conſtitute ſo many Tables of Equations for that Purpoſe; and they will all be neceſſary where it is required to have the Moon's Place determined to any Degree of Accuracy, as in ECLIPSES, the Problem of finding the LONGITUDE, &c..

3852. In this Algebraic Expreſſion, we find all the Equations in common Uſe, beſides a Number of others, which could never have been thought of had they not been brought to Light by the Analytic Art; and for want of them, all the Lunar Tables hitherto publiſhed muſt, of courſe, be very defective. Nor is it to be wondered at, that in a Combination of ſo many Incidents of ſuch variable Influence, the Moon's Motion ſhould be affected in ſo many different Regards, and require ſuch a Number of Equations, with ſo complex a Variety of Arguments.

3853. The *Numerical Co-efficients* of each Term being conſtant, and the *literal Parts* by which they are multiplied variable, it is plain, the Values of each Equation will ever be in the Ratio of thoſe *literary Expreſſions*, which therefore will be the Arguments of thoſe Equations in their reſpective Tables.

3854. Before the Value of the Terms or Equations can be expreſſed in regard to Quality, that is, whether the Sum of its Parts be *affirmative* or *negative*, viz. to be *added* or *ſubtracted* from the Mean Place (x), it muſt be conſidered, that the Sine of any Arch leſs than 180 Degrees is *poſitive*, and the Sine of an Arch between 180° and 360° is *negative*; as alſo, that the Coſine of an Arch in the firſt and third Quarters of a Circle is *poſitive*, but in the Quarters, *negative*.

3855. Thus for Example, if in the Terms of the firſt Equation we ſuppoſe $y = 20^\circ$, then $2y = 40^\circ$, and $3y = 60^\circ$, and the Sine of each poſitive. But if $y = 60^\circ$, then its Sine is poſitive, and ſo is that of $2y = 120^\circ$; but the Sine of $3y = 180^\circ$ is nothing, ſo that laſt Part vaniſhes. Laſtly, let $y = 70^\circ$, its Sine is *poſitive*, as alſo the Sine of $2y = 140^\circ$; but the Sine of $3y = 210^\circ$ is *negative*.

3856. Not only the *Quality*, but alſo the *Quantity* of each Term or Equation becomes known, from *Nothing* to its *Maximum* State; becauſe when the Sum of the Terms of which the Argument conſiſts are together equal to nothing, it will ſhew the Circumſtances of the Moon, when that Equation is nothing or beginning. Alſo becauſe the Sine of 90° is the greateſt of all Sines, it will from thence appear, when each Equation is in its *Maximum* State, and what its Quantity then is becauſe the Sine of $90^\circ = 1$, or Radius.

3857. But in order to expreſs this Matter more clearly, let the Mean Longitude of the *Sun*, *Moon*, her *Node*, and *Apogee*, be denoted by ☉, ☾, ☊, and P. Then will $y =$ ☾ $- \mathrm{P}$; $t =$ ☾ $-$ ☉, and $s =$ ☾ $-$ ☊. Therefore with regard to the firſt Term or Equation, when $y = 0 =$ ☾ $- \mathrm{P}$, we have ☾ $= \mathrm{P}$, or the Moon is in Apogee. Alſo when $y = 90^\circ$, this Equation is a *Maximum*; and when $y = 180^\circ$, it again becomes nothing. Therefore it is evident this Term is the ſame with what is uſually called, *The* EQUATION of the CENTER (3797).

3858. With regard to the ſecond Term, whoſe Argument is $2t - y = \overline{2\,\text{☾} - 2\odot} - \overline{\text{☾} - P} = \text{☾} + P - 2\odot$, it is eaſy to ſee, that as it depends upon the variable Longitude of the Moon's Apogee in Part, it makes that Equation which is commonly called the EVECTION or EQUATION of the APOGEE. This Equation begins when $2t - y = 0$, or when $2t = y$; and is a Maximum when $2t - y = 90^\circ$; in this Caſe $4t - 2y = 180^\circ$. which makes the ſecond Part of the Term vaniſh; and conſequently this Equation, when a Maximum, is $1^\circ\ 20'\ 18'',3$. In MAYER's Tables it is $1^\circ\ 20'\ 42''$.

3859. The *third Term*, or Equation, having its Argument (t), ſhews it to be that called the VARIATION, or REFLECTION in common Lunar Tables, and of which we ſpoke in the Theory (3810). When $t = 0$, or the Moon is *New*, this Equation begins; and is a Maximum when the greateſt Part $39'\ 31'',4 \times$ Sine of $2t$ is ſo, that is, when $2t = 90^\circ$, or $t = 45^\circ$, *viz.* in the *Octants*, as we there ſhewed. In this Caſe, $4t = 180^\circ$, and the laſt Part vaniſhes; and the firſt will amount to about $1'\ 30''$; therefore $39'\ 31'',4 - 1'\ 30'' = 38'\ 1''\ \frac{1}{2}$; but in the Octants where the Sine of t is negative, the Sum $39'\ 31'',4 + 1'\ 30'' = 41'\ 1''$ will be the *Maxima* of this Equation. In *Mayer*'s Table of the VARIATION, theſe *Maxima* are $39'\ 1''$, and $41'\ 41''$.

3860. The *fourth Term*, whoſe Argument is barely (z) or the *Sun's Anomaly*, is that called the *Solar* EQUATION, and could have had no Place if the Solar Orbit had been a Circle. This is therefore every Way analogous to the *Equation of the Sun's Center* (3797). Indeed the Eccentricity of the annual Orbit is but ſmall in itſelf, yet ſo extenſive in its Influence as to affect *no leſs than one Half* of thoſe numerous Lunar Equations in (3838).

3861. The *fifth Term* contains a ſmall Equation whoſe Argument is $2s - 2t = 2 \times \overline{\odot - ☊}$, or the *double Diſtance of the Sun from the Moon's aſcending Node.* It is therefore plainly that which Sir I. NEWTON calls the *Second Semeſtral*, or *Semi-annual* EQUATION. This begins when $s = t$, or $\odot = ☊$, that is, when the Sun is in the Node; and it is a *Maximum* when $2s - 2t = 90^\circ$, or $s - t = 45^\circ$, that is, when the *Line of Nodes is in the Octants of the Sun.* And laſtly, it vaniſhes when $2s - 2t = 180^\circ$, or $s - t\ (= \odot - ☊) = 90^\circ$, or the Sun is 90° diſtant from the Node.

3862. The *ſixth Term* is the *firſt Semeſtral Equation*, whoſe Argument is $2y - 2t$; hence $y - t = \odot - P$, which ſhews that this is another Equation relative to the *Moon's Apogee*; and begins when $\odot = P$, or the Sun is in the ſaid Apogee. It is a *Maximum* when $\odot - P = 45^\circ$, or when the Line of the Apſides is *in the Octants of the Sun*; and the Equation vaniſhes when $2y - 2t = 180^\circ$, or $\odot - P = 90^\circ$, that is, when the Apſides are in the Quadratures.

3863. All theſe Things are nearly the ſame as you find delivered by Sir I. NEWTON in the Scholium to the 35th Prop. Book III. of his *Principia*. The following Terms contain Equations almoſt new, and without any particular Titles; and being but ſmall, and of the ſame general Nature with thoſe already treated of, they require nothing further to be ſaid by way of Explication.

CHAP. VI.

Of the Conſtruction of the TABLES of the PLACE of the NODE, INCLINATION of the ORBIT, and *Horizontal* PARALLAX.

3864. THE *Supplement* of the Node is uſed in theſe Tables, inſtead of the Place of the Node itſelf, for a Reaſon hereafter to be given. The Mean Place thereof makes the firſt Column of theſe Tables; and this Mean Place is corrected by two ſmall Equations, *viz.* 2′ : 3″ S. *y*, and 10′ : 23″ S, *z*, whoſe Arguments being *y* and *z*, theſe Tables are denoted by A and D.

3865. Let the correct Place of the Supplement of the Node be called N; and if to this be added the correct Place of the Moon, you will have the true Argument of the Moon's Latitude, which call L. Then the Equation for the Reduction of the Moon's Place to the Ecliptic (as deduced from the Theory) is —6′ : 57″ S. 2 L. Therefore the Table denoted by L contains the Numbers for this Reduction, calculated from that Expreſſion.

3866. The Equation of the Equinoctial Point from the firſt Star of *Aries* (whoſe Argument is the Diſtance of the Node N) being added to the Moon's Place reduced to the Ecliptic, gives her *true* LONGITUDE from the ſaid Equinoctial Point.

3867. The LATITUDE *of the* MOON, or its Supplement, in theſe Tables, is calculated from the Expreſſion, or Angle, whoſe Sine is that of 5° : 18′ : 38″ × Sine of L; the firſt Angle is the Mean *Inclination of the Moon's Orbit* to the Plane of the Ecliptic, and is conſtant; the Sine of which multiplied into the Sines of all the Values of L makes the General Table of the Moon's *Co-Latitude*, or Diſtance from the Pole of the Ecliptic, whoſe Argument is L.

3868. This LATITUDE is corrected by four Tables of Equations calculated from the Expreſſion of the Latitude, deduced from the Theory, as delivered (3841) of which the firſt is made from the firſt Term of that Expreſſion, *viz.* 8′ : 46 S. $\overline{l-k}$; and therefore has for its Argument L — E, which is the ſame as $l-k$.

3869. The three other Tables are made from the remaining three compound Terms, and are to be entered with a double Argument, *viz.* the firſt with L and A (correſponding to $l-y$); the ſecond with L — E and A (anſwering to $l-k$ and y); and the third with L — E and D (the ſame as $l-k$ and z, in the laſt Term). And thus the true Co-latitude is obtained from the Sum of theſe Equations.

3870. The Expreſſion for the HORIZONTAL PARALLAX conſiſts of *Nine Terms* (3842) which therefore indicate as many Tables of Equations to be neceſſary when the greateſt Exactneſs is required. But ſince *Five* of the Nine are ſo very ſmall, as to amount to more than about 5″ altogether, it was judged ſufficient in all common Caſes to calculate only *Four* particular Tables for the Equations of the Parallax, *viz.* thoſe whoſe Arguments y, $2t-y$, t, $2t+y$, and are therefore denoted by A, B, C, and d.

3871. But leſt any thing ſhould be wanting for the utmoſt Accuracy which the Theory affords, the Author has calculated Five Supplemental Tables of the Parallax from the other Five Terms of the Expreſſion, which depend on the Arguments $2t-y-z$, $2t-z$, $y-z$, $y+z$, $4t-y$, and are therefore denoted by b, c, e, f, g; of which the three firſt are poſitive, and the two laſt negative.

3872. It is peculiar to the Conſtruction of Mr. CLAIRAUT's Tables, that the Equations *are all poſitive*; every-body knows the Difficulty and Confuſion that the common heterogeneous Syſtem of *Poſitive and Negative Equations* induces in all practical Calculations. And Experience will ſoon evince with how much more Pleaſure and Eaſe thoſe tedious

Proceſſes may now be diſpatched by the ingenious *Navigator* and *Aſtronomer*. Nor is it difficult to ſee the Reaſon of the Artifice our Author has uſed for this Purpoſe. For let any *Mean Motion or Place* be denoted by M; the *Equation* by q; and the *True Place* by t; then will $M \mp q = t$.

3873. Now the Quantity t here depends upon an ambiguous Operation, *viz.* either the *Addition* or *Subtraction* of q, according to the Quality thereof. Therefore to take away this Ambiguity in the Proceſs, let the Equation q be tranſpoſed, and we have $M = t \pm q$; and now let any conſtant Quantity r, greater than the Equation q, be ſubtracted from both Sides, and we ſhall have $M - r = t \pm q - r = M$; therefore $M \mp q + r = t$. Hence if the Equation q be increaſed by the conſtant Quantity r, the new Equation $\mp q + r$ will *always be poſitive or addititious*, becauſe r is ever greater than q; and when $q = o$, then $M + r = M = t$.

3874. As the 20 Equations for correcting the Moon's mean Place (3846) do not all of them amount to 11 Degrees; therefore Mr. CLAIRAUT has taken this Quantity from the Mean Place of the Moon in the Tables of Epochs, and dividing the ſame into Parts proportional to the Quantity of each Equation, theſe Parts become the conſtant Quantity r to be added to each Equation, as the whole 11° is a conſtant Quantity, by which the Mean Places M are diminiſhed, and then M will be thoſe Mean Places for the reſpective Epochas in theſe new Tables.

3875. To give a clear Idea of this Matter, one Example will be ſufficient. The Mean Place of the Moon the Beginning of the Year 1736 (in *Mayer*'s Tables) was $M = 4^s : 17^\circ : 22' : 14''$; this leſſened by 11°, is $4^s : 6^\circ : 22' : 18'' = M$ in Mr. *Clairaut*'s Tables for the ſame Year. Then this $11^\circ = r$ is diſtributed among the ſeveral Equations, as in the Table following:

		°	′	″
To the Equation of the Center	A	7	0	0
The Evection	B	2	0	0
The Variation	C	0	50	0
Firſt Solar Equation	D	0	29	0
Second Solar ditto	E	0	1	0
Semeſtral Equation	*a*	0	4	0
All the other ſmall ones, *b*, *c*, *&c*-		0	26	0
For the Reduction to the Ecliptic	L	0	9	0
Equation of the Equinox	N	0	1	0
Total		11	0	0

3876. The ſame Principle is applied to the four Tables for correcting the Moon's Co-latitude in the General Table L, where the Numbers are diminiſhed by the conſtant Quantity 10′ 22″, which is divided among the four Tables of Equations as below:

		′	″
To the Table	L — E	8	44
To ditto	L & A	0	34
To ditto	L — E & A	0	28
To ditto	L — E & D	0	36
Total		10	22

3877. Laſtly, the Mean *Horizontal Parallax* of the Moon being diminiſhed by 1′ 4″, becomes 55′ 59″, to which the Numbers being added ariſing from the ſecond Term of the Expreſſion of the Parallax (3842) make the firſt Table whoſe Argument is A; and the ſaid 1′ 4″, being divided into proper Parts, are added to the Equations in the other three Tables B, C, and D, to make all their Numbers *poſitive.*

3878. Indeed the two laſt of the very ſmall Tables of the Parallax *f* and *g* are *negative*; but it could not be thought worth while to undertake a laborious Taſk, for the ſake of anſwering ſo trifling an End, as rendering them poſitive.

CHAP. VII.

Of the TABLES of the HOURLY MOTIONS of the MOON; with the *Rationale* of their CONSTRUCTION.

3879. THE Tables we have hitherto treated of, are ſuch as give the true *Longitude*, *Latitude*, and *Parallax* of the Moon; there yet remains a Set of ſmall Tables for aſſigning, with the utmoſt Accuracy, the *true Hourly Motion* of the Moon; the Nature and Conſtruction of which will be eaſy to underſtand from the foregoing Principles; and as it is a Matter of the greateſt Moment in the principal Problems of Aſtronomy and Navigation, to know the real Velocity of the Moon's Motion at a given Time, we ſhall next explain the Tables reſulting from this new Theory, as calculated by our celebrated Author for that Purpoſe.

3880. It has been abundantly ſhewn in the Phyſical Theory, that the *Moon's Motion is variable* on many Accounts, the principal of which, however, is, her variable Diſtance from the Earth, as moving in an eccentric Orbit, and ſuch an one too, whoſe Eccentricity is itſelf always variable. Now as, in general, a Planet moves ſlower the farther it is from the Center of Force, and the farther we are removed from an Object the leſs its Diameter appears, therefore the *Horizontal Parallax* of the Moon will prove a general Index or Argument of the *Moon's Velocity*, ſince they both increaſe or decreaſe together.

3881. Suppoſing the Earth a Sphere or perfect Globe, the *Greateſt*, *Mean*, and *Leaſt Horizontal Parallaxes* of the Moon are known by Obſervation to be about 54′ : 10″, 56′ : 58″, and 60′ : 26″, according to MAYER; but in Dr. HALLEY's Tables we find them ſtated at 53′ : 34″, 57′ : 16″, and 59′ : 43″; and in CASSINI's Tables they are 54′ : 33″, 57′ : 54″, and 62′ : 11″. Whence it appears there is a conſiderable Uncertainty in regard to the true Quantity of the Moon's horizontal Parallax, therefore the Reader will find the Argument or Parallax in the firſt of theſe Horary Tables in its greateſt Extent, *viz.* from 52′ to 63′. According to which you have all Degrees of Velocity in the Moon's Motion from 27′ : 4″ to 39′ : 52″ *per* Hour.

3882. The Corrections of the hourly Motion of the Moon, it is evident, will have the ſame Arguments as belong to the Equations of the general Expreſſion of the Moon's Place; and accordingly we have three Tables, with the Arguments A, B, and C reſpectively; and according to the Quantity of theſe Arguments at the given Time, you take out the Correction from each. That afforded by the Argument A, or Moon's *Mean Anomaly*, is but ſmall. The Evection B gives one not much larger; but by the Variation C, or the *Diſtance of the Moon from the Sun*, it is very conſiderable, amounting to 18″; the Reaſon of which is plain from the Phyſical Cauſe (3810).

3883. The Equations of theſe Tables are made *poſitive* alſo for the Eaſe of Calculation; and theſe alone give the hourly Motion of the Moon to greater Exactneſs than is generally required; but to ſhew the Perfection of the Theory, and this Set of Tables, our Author was at the Pains of calculating *Eight* ſmall Equations, anſwering to the Arguments D, a, b, c, d, g, h, i, of which the ſeven-firſt are always poſitive, and the laſt negative. The Equations correſponding to the Arguments e, f, are too ſmall to be regarded.

3884. After this follows a Table of the *Hourly Variation of the Reduction to the Ecliptic*, by which is obtain'd the Moon's hourly Motion in Longitude. As the Place of the Moon, and her Argument of Latitude, are reckoned from different Points of the Ecliptic, their hourly Variation cannot be preciſely the ſame, but the latter will exceed the former about 8″.

3885. Having the hourly Variation of the Argument of Latitude, you enter the Table L or Table XXXI. with the Argument of Latitude, and obſerve in the Column of Differences that which correſponds thereto; then ſay, As 60′ is to the Diff. in the Table, ſo are the Minutes and Seconds in the hourly Variation of the Argument of Latitude to the Proportional Part of that Difference in Minutes and Seconds, which will be the hourly Variation of the Moon's Co-latitude, with one Correction.

3886. And then, having the Argum. L—E, you enter therewith the laſt ſmall Table, and take the Number correſponding thereto, which added to the above, will give the true *Hourly Variation of the Moon's Co-latitude*, and conſequently, *of the Latitude* itſelf.

3887. But in this ſmall Table, and that preceding it, the Numbers are affected with the different Signs — and +, becauſe they are ſometimes *Negative*, and ſometimes *Poſitive*; and accordingly are to be *ſubtracted* or added as the Sign directs. The Reaſon thereof is, that in the firſt Quarter of the Moon's Orbit the Co-latitudes of the Moon are decreaſing, and their Differences alſo decreaſe, and in this Caſe they are to be looked upon as *Negative Quantities*. And for contrary Reaſons they will be *Affirmative* in the *Second Quadrant* of the Orbit. In the third and fourth they are again *Negative* and *Affirmative*.

3888. Theſe Particulars well underſtood, and attended to, will render Mr. CLAIRAUT's new Tables very eaſy in Practice, as will appear by the Example in the next Chapter. It remains only to obſerve, that among theſe Tables ſome of the moſt common Tables of the Moon do not appear; but they are virtually contained in theſe, and whenever they are required their Uſes are eaſily ſupplied by, and deduced from theſe. Thus for Example, if it be required to find the MOON'S APOGEE for any given Time, it is immediately had by the given Places of the Sun and Moon, and the Equation B for that given Moment, by the Theorem in (3858) *viz.* $2t - y = B = \leftmoon + P - 2\odot$, from thence we have $P = 2\odot + B - \leftmoon =$ the *Long.* of the *Apogee required.* And at the Time of a Solar Eclipſe, when $\odot = \leftmoon$, then $P = \odot + B$. But in theſe Tables the Mean Long. of the Moon muſt be increaſed by the 11 Degrees taken from it, as *per* (3874).

3889. By having the true Place, Latitude, and Longitude of the Moon for a given Time, you have true Quantity of the INCLINATION of *her* ORBIT to the Ecliptic for the Time, by the Solution only of a right-angled Spherical Triangle as taught (1792).

3890. The *Horizontal Parallax* being known for any Time, the Diſtance of the Moon from the Earth is thereby alſo known in Semi-diameters of the Earth; and becauſe the true Anomaly and Equation of the Center is known, therefore the ECCENTRICITY of *the Lunar* ORBIT is known alſo, for that Inſtant of Time, by the Solution of an oblique Triangle ſimilar to that of Inſtitut. (3800).

CHAP. VIII.

The AUTHOR'S METHOD of CALCULATION by his NEW TABLES, illuſtrated by EXAMPLE.

3891. WE ſhall now give the *Author's Example* of Calculation from his New Tables, which is for finding the Moon's Place, Latitude, *&c.* near the Time of the laſt great Eclipſe of the Sun, *viz. Anno Dom.* 1764, *March* 31 D 22 H 40′ 45″, or, in the vulgar Reckoning, *April* 1 D 10 H 40′ 45″, becauſe the *Civil Day* begins at 12 o'Clock at Night, and the *Aſtronomical Day* at 12 at Noon (3781) or 12 Hours before the other.

3892. The Mean Places of the Supplement of the Node and of the Moon, are collected as in the Table below:

		Supp. of ☊				M. Place of ☽			
		s	°	′	″	s	°	′	″
An. Dom, - -	1764	11	20	19	37	8	1	22	34
March -	-		3	7	28	1	27	24	26
Day -	31		1	38	30	1	18	28	6
Hour - -	22			2	55		12	4	42
Minutes - -	40				5			21	58
Seconds -	45				0				25
		11	25	08	35	11	29	42	11

3893. Having thus obtained the Mean Places of the Moon and her Node, the true Place of the Moon is found by the following 20 Arguments and their Corrections:

	A				B				C				D			E		
	s	°	′	″	s	°	′	″	s	°	′	″	s	°	′	s	°	′
1764	7	21	39	57	2	11	51	46	11	1	45	51	6	1	43	6	2	14
March	1	20	50	3	10	7	40	27	11	29	15	15	1	28	9	4	2	33
31 D	1	15	0	53	11	20	48	42	0	17	54	47	1	0	33	2	4	24
22 h	0	11	58	34	0	10	22	24	0	11	10	30	0	0	54	0	1	54
40′			21	46			18	52			20	19			2			3
45″				24				21				23			0			0
	11	9	51	37	0	21	2	32	0	0	27	5	9	1	21	0	11	8

	a	b	c	d	e	f	g
1764	721.96	694.75	338.24	486.55	138.66	148.31	042.64
March	143.28	693.12	834.33	137.06	979.68	302.74	850.51
31 D	075.30	889.60	014.60	224.60	040.20	209.90	074.00
22 h	2.20	26.30	59.60	95.30	30.80	35.80	90.90
40′	0.10	0.80	1.80	2.90	0.90	1.10	2.80
	942.84	304.57	248.57	946.41	190.24	697.85	060.85

	h	i	k	l	m	n	o	p
1764	706.19	565.0	704.4	347.9	981.8	948.7	782.2	087.4
March	195.08	139.1	016.2	157.4	975.5	448.1	120.9	427.8
31 D	153.30	175.0	059.0	184.0	140.0	235.0	165.0	276.0
22 h	34.10	64.0	32.0	65.0	93.0	7.0	64.0	38.0
40′	1.00	2.0	1.0	2.0	3.0	0	2.0	1.0
	089.67	945.1	812.6	756.3	193.3	638.8	134.1	830.2

3894. We have now the Value of the Arguments great and ſmall for the given Time; theſe are next to be found in their proper Tables, and the Corrections pertaining to each taken out and added together as below:

Corrections.

Argum. ° ′ ″

A = 11 9 51 37 — 9 2 5
B = 0 21 2 32 — 1 32 58
C = 0 0 27 5 — 0 50 37
D = 9 1 2 0 — 0 17 45
E = 0 11 8 0 — 0 0 49

Sum 11 44 14

Arg. Cor. ′ ″

a = 943 — 6 19
b = 305 — 7 5
c = 249 — 0 20
d = 946 — 5 7
e = 190 — 5 14
f = 698 — 4 43
g = 061 — 2 35

Sum 31 23

Arg. Cor. ′ ″

h = 090 — 3 47
i = 945 — 0 17
k = 813 — 0 55
l = 756 — 0 7
m = 193 — 0 49
n = 639 — 0 11
o = 134 — 0 12
p = 830 — 0 4

Sum 6 22

	°	′	″
	11	44	14
Sum of all the Corrections -		31	23
		6	22
	12	21	59

	s	°	′	″
3895. Then to the Moon's Mean Place	11	29	42	11
Add the Total Correction - -		12	21	59
And the Sum is the Moon's true Place in her Orbit, *viz.* - - -	0	12	04	10

3896. The Mean Place of the Supplement of the NODE is next to be corrected by means of the two Tables A and D (Tab. 27 and 28).

	s	°	′	″
Mean Place - - - -	11	25	8	35
The Arg. A = 11 9 51 37 —			2	18
D = 9 1 2 0 —			27	23
True Place of the Node's Supplement, N =	11	25	38	16
To which add the Moon's true Place -	0	12	4	10
The Sum is the *Argument of Latitude*, L =	0	7	42	26

3897. Having the Argument of Latitude L, and alſo the Supplement of the Node N, we find, by the firſt, the Moon's Place reduced to the Ecliptic; and by the latter, her Longitude from the Equinoctial Point (3865) &c. thus:

	s	°	′	″
To the Moon's Place in her Orbit -	0	12	4	10
Add the Reduction for L = 7° 42′ 26″ —			7	9
The Sum is her Mean Place in the Ecliptic	0	12	11	19
Add the Correction for N = 11 25 38 16 —				59
The Sum is the Moon's true Long. in the Ecliptic - - - - - -	0	12	12	18

3898. The LATITUDE of the Moon remains to be inquired after, and corrected. In theſe Tables the *Co-latitude* is calculated for every Value of the Argument of Latitude L, and then corrected by the Equations mentioned in (3868, *&c.*) Thus in the preſent Caſe,

		s	°	′	″	°	′	″
We have - - -	L =	0	7	42	26 —	89	8	18
(And by (3893) - -	E =	0	11	8	0)			
Therefore add the Corrections correſponding to -	L — E =	11	26	34	0 —		9	16
	A — L =	11	2	9	11 —			51
	A & L — E	-	-	-				29
	D & L — E	-	-	-			1	10
The Sum is the Moon's Co-latitude -						89	20	4
Therefore the true Latitude is - -						0	39	56

3899. To find next the *Horizontal* PARALLAX of the Moon for the given Time, we have in the Tables 36, 37, 38, 39 the Quantities anſwering to the Arguments A, B, C, d; as alſo the ſmall Corrections from the five Supplemental Tables, which here follow:

	′	″			″
For A	53	12	Supp. b		1,4
B		2,2	c		2
C		56,2	e		2,4
d		0,2			
			Poſitive	+	5,8
Sum	54	10,6	Neg. f	—	4,7
Subduct the Diff.	—	0,6	q	—	1,7
			Diff.	—	0,6
Remains the true Horiz. Parallax —	54	10			

3900. Having the Horizontal Parallax, the Moon's *Hourly* MOTION anſwering to it is found in the Tables appropriated thereto, as below:

	′	″	′	″	Small Correc.		″
Horiz. Paral.	54	0	29	12,7			
		10		11	D		1
					a		1,2
	54	10	29	23,7	b		1,1
Add the Equations A				0,6	c		1
B				5,3	d		0,1
C				18	g		0,1
					h		1,8
			29	47,6			
Subduct			—	1,1		+	6,3
					i	—	7,4
Remains the Ho. Motion			29	46,5			
					Diff.	—	1,1

	′	″
3901. From this Hor. Motion in the Orbit	29	46,5
Subduct the Hor. Variation of the Reduction to the Ecliptic	—	7,7
The Difference is the Moon's Hourly Motion in Longitude	29	38,8

3902. The Hourly Variation of the Argument of Lat. L, our Author makes 8″ more than that of the Moon in her Orbit; which therefore, in the preſent Caſe is 29′ 55″. Then (in Table 31) you find againſt the preſent Argument of Lat. (L = 7° 42′) the Diff. 5′ 20″ in the Diſtance of the Moon from the Pole of the Ecliptic anſwering to *One Degree* of the ſaid Argument of Latitude. Therefore ſay, As 1 Deg. or 60′ is to 5′ 20″ ſo is 29′ 55″ to 2′. 39″,6 = *Mean Hourly Variation of the Co-Lat. of the Moon*, which in the Calculation muſt be conſidered as a *Negative* Quantity, becauſe upon the Decreaſe (3886).

3903. Not only the Co-latitude itſelf, but alſo its greateſt Equation (in Table 32) correſponding to the Arg. L — E, is ſubject to a ſenſible Variation, and therefore the laſt ſmall Table is conſtructed for correcting this Equation. Therefore

	′	″
To the Hourly Variation of Co-Lat. - —	2	39,6
Add the Equat. anſwering to L — E - —		4,2
The Sum is the true *Hourly Variation of the Moon's Co-Lat. decreaſing* - -	—2	43,8

3904. In the laſt Place, as theſe Tables give the *Mean Time* at PARIS, we ſhall have the Mean Time at LONDON, by deducting 9′ 46″ from the Time at *Paris* (3787) *viz.*

	H	′	″
Mean Time at PARIS, *March* 31 -	22	40	45
		9	46
The Mean Time at LONDON, *March* 31 -	22	30	59
Subtract the Equation of Time * - -		3	50
The Apparent Time at LONDON, *March* 31	22	27	9
Or, in the common Reckoning, *April* 1 -	10	27	9

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* The Equation of Time has been largely explained, and Tables thereof given, in the Second Volume of this Work, from Inſtitution 3641 to 3696.

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CHAP. IX.

The Uſe of the *Solar* TABLES in finding the TRUE PLACE of the *Sun*, and the Requiſites of a *Solar* and *Lunar* ECLIPSE, exemplified.

3905. OUR celebrated Author has given us the Calculation of the Moon's Place, *near the Time of the Ecliptic Conjunction*, in the laſt memorable SOLAR ECLIPSE; but as he has ſaid nothing of the Sun's Place at the ſame time, nor of the Eclipſe itſelf, I ſhall here ſupply that Part, leſt any one ſhould think theſe Tables deficient in any Particular relative to a *Solar or Lunar* ECLIPSE, or in the greateſt Preciſion of exhibiting the Phænomena of either.

3906. The Place of the Sun for the ſame Moment of Time is obtained from MAYER's Solar Tables, as below:

		M. Long. of ⊙					Long. of Ap.			
		s	°	′	″		s	°	′	″
1764	-	9	10	36	42	—	3	8	51	37
March 31	-	2	28	42	30	—				16
22 H	- - -			54	13					
40′	- - -			1	39		3	8	51	53
45″	- - -				2					
⊙ Mean Place	-	0	10	15	6					

3907. Then from the Sun's Mean Place	0	10	15	6
Take the Mean Place of the Apogee -	3	8	51	53
Remains the Sun's *Mean Anomaly* -	9	1	23	13

3908. Then to the Sun's Mean Place -	0	10	15	6
Add the Equation correſponding to that Anomaly		1	55	23
The Sun's true Place - - -	0	12	10	29

3909.

	s	°	′	″
3909. From the Moon's Longitude in the Ecliptic - - - - - -	0	12	12	18
Take the Place of the Sun - -	0	12	10	29
The Difference is - - - -			1	49

Whence it appears, that as the Moon is before the Sun in the Ecliptic, ſhe is paſt the *Conjunction* at the given Time.

3910. But by having the Place of the Sun and Moon, at the given Inſtant, and their Hourly Motions, or reſpective Velocities, it will be eaſy to find the true Time of their Ecliptic Conjunction, and the true Longitude in which it happened, by Rules or Analogies deduced from the Theorem in (243). To make this Matter clear, let ♈ M be a Part of the Ecliptic in which the Conjunction happens (fig. 5.), ☊ E a Part of the Moon's Orbit properly inclined to the Ecliptic; and let S be the Place of the Sun, and M that of the Moon reduced to the Ecliptic, at the Time above ſpecified; and laſtly, let N be the Place of the CONJUNCTION, or that in which the MOON was NEW; whoſe Longitude is now to be found.

3911. We have ſeen (3900) that for the given Time the *Moon's hourly Motion* in Longitude was 29′ 39″ = 1779″; and the *Sun's hourly Motion* for his preſent Anomaly (3907) is 2′ 28″ = 148″. The Difference of theſe Motions is 1631″; alſo the Diff. of the Places of the Luminaries in the Ecliptic is 1′ 49″ = 109″ = SM. Then by the fore-mentioned Theorem we have this Analogy, As 1631″ is to 1779″ ſo is 109″ to 119″ = 1′ 59″ = MN, which being deducted from the Moon's Long. 12° 12′ 18″ gives the Longitude of the Point of Conjunction N = 12° 10′ 19″ as required.

3912. Then by the following Analogy we have the *Time of the Conjunction*, viz. As 1779″ is to 3600″ (= 1 Hour) ſo is 119″ to 240″ or 4′; therefore ſubducting this from the

	H	′	″
Apparent Time at LONDON, *Apr.* 1, -	10	27	9
		4	0
We have the Apparent Time at LONDON of the true Ecliptic Conjunction, *April* 1 -	10	23	9

3913. Our Author has given no Table of the *Moon's Diameter*, as he knew it was not neceſſary; becauſe ſince her Diameter bears a conſtant Proportion to her Horizontal Parallax, when the Parallax is known her Diameter is known of courſe. To ſee the Reaſon of this, let A M be the Semidiameter of the MOON, and C B that of the EARTH (Fig. 6.) and draw the Lines A B and C M; then is the Angle C A B as $\frac{BC}{AC}$, and the Angle A C M is as $\frac{AM}{AC}$ (1270); therefore the Moon's Horizontal Parallax C A B is to the Moon's Apparent Semi-diameter or Angle A C M, in the conſtant Ratio of B C to A M, or of *the Diameter of the Earth to that of the Moon.*

3914. Now by the beſt Obſervations hitherto made, it appears that the Diameter of the Earth is to that of the Moon as 55½ to 15, nearly. Therefore if the Moon's Horizontal Parallax be given at any Time, as in the preſent Caſe we have found it to be 54′ 10″ (3899) we ſhall find her Apparent Diameter by ſaying, As 55½ is to 15 ſo is 54′ 10″ to 14′ 38″=the Moon's Semi-diameter at the Time of that Eclipſe.

3915. In order to have the true *Data* for conſtructing the Eclipſe of the Earth or Moon, it is neceſſary to find the *Inclination of the Apparent Path* of the Moon to the Ecliptic at the Moment of the Eclipſe, for this is a little different from the *Inclination of her real Orbit*. To illuſtrate this, let ☊ (Fig. 5.) be the Place of the Node; ☊ E the Orbit of the Moon; it will be neceſſary to know the Inclination thereof, or Angle E ☊ M, at the Time of the Eclipſe.

3916. In order to this, we muſt recollect that the Moon's Mean Place was diminiſhed 11 Degrees to be diſtributed among the 22 Equations (as ſhewn 3875) but it there appears that the Equations belonging to L and N have 10′ to their Share; conſequently the 20 Equations of the Moon's Place repay only 10° 50′ of the 11° borrowed; and therefore the Moon's Place in her Orbit, as expreſſed (3895) is deficient by 10′, her Place being really 12° 14′ 10″.

3917. Again, the Epoch of the Mean Place of the Supplement of the Node is made 10′ too little, that a Compenſation may be made for 20′ given to the two Equations of the Node A and D (3864) and to have an Exceſs of 10′ in the correct Supplement of the Node; for by this Contrivance, the Supplement with 10′ too much, being added to the Moon's Place which is 10′ deficient, will give the true Quantity of the Argum. of Lat. L.

3918. Therefore the true Supplement of the Node being 11 s 25° 28′ 16″, the true Place of the Node itſelf will be 4° 31′ 44″ of *Aries*; which ſubducted from ♈ M the Long. of the Moon 12° 12′ 18″, will leave 7° 40′ 34″ = ☊ M. Therefore in the Triangle E ☊ M all the Sides are known, whence the Angle at ☊ will be found = 4° 58′.

3919. To find the Latitude N C at the Conjunction, ſay, As ☊ M = 460′,6 is to ☊ N = 458′,6, ſo is the Lat. M E = 2396″ to the Lat. N C = 2386″ = 39′ 46″.

3920. It is next to be obſerved, that the *Apparent Path* of the Moon is not that of her Orbit ☊ C, but ſome other Line D C, making a larger Angle C D N with the Ecliptic (Fig. 7.) For let N be the Center of the Earth or Place of the Sun oppoſite to it, and C that of the Moon at the Moment of Conjunction; and let N G and C A repreſent the reſpective Velocities, or *Horary Motions* of the Sun and Moon; join A G, and through A draw the Line A B parallel to ☊ M, in which take A *a* = G N, and draw *a* N, which will be equal and parallel to A G.

3921. Then when the Eye (or the Sun) was at G, the Moon was ſeen in A, and when the Sun or the Eye is at N, as the Moon at A was ſeen from G, *viz.* under the ſame Angle *a* N ☊ = A G ☊, in the ſame Direction *a* N parallel to A G, and at the ſame Diſtance N *a* = G A. Therefore to an Eye conſidered at Reſt at N, the Moon will appear to have deſcribed the Path C *a* inſtead of C A; and her Apparent Place will be at (*a*); through *a* draw the Line C D to interſect the Ecliptic in D, and that right Line C D will therefore be the *viſible Way or Path of the Moon* at the Time of the Eclipſe.

3922. To find the Angle C D N, which the Lunar Path C D makes with the Ecliptic, is the next Thing neceſſary. To this End it muſt be conſidered, that becauſe A *a* = G N, therefore *a* C may be eſteemed equal to the Difference of the Hourly Motions of the two Luminaries, that is, C A — G N = *a* C = 1631, while C A = 1779. But C A : C *a* : : C ☊ : C D : : Angle C D N to the Angle C ☊ N. That is, As 1631 : 1779 : : Sine C ☊ N = 4° 58′ to the Sine of C D N = 5° 25′.

3923. From the Point N make N F perpendicular to the viſible Path C D, then will the Angle C N F = Angle C D N; and it is plain the Point F will be neareſt the Point N of all in the Line C D, and conſequently that to an Eye placed in the Center of the Earth the Line N F will be the *neareſt Diſtance of the Centers* of the Sun and Moon; and therefore F is the *Place of the Moon in the Middle Moment of the Eclipſe.*

3924. From what has been ſaid it will eaſily appear to the attentive young Student, that what we uſually call an *Eclipſe of the Sun*, is more properly an *Occultation of the Sun by the Diſk of the Moon*; and the *Phaſes of a Solar Eclipſe* are only the Quantities of ſuch an Occultation to the different Inhabitants of the Earth, who, according to their various *Latitudes* and *Lunar Parallaxes*, may ſee the Eclipſe or Occultation *total*, *partial*, or *none at all*.

3925. What, in this Caſe, may be truly called an *Eclipſe*, is the Paſſage of the *Moon's Shadow* and *Penumbra* over the *enlightened Diſk* of the Earth, as beheld from the Moon, in the ſame Manner as we ſee a real ECLIPSE OF THE MOON, in her Paſſage through the Shadow of the Earth. But as this Affair will require a further Explanation, we ſhall give it in the following Chapter.

CHAP. X.

The *Fundamental* PRINCIPLES, or THEORY, of *Solar* and *Lunar* ECLIPSES inveſtigated and explained.

3626. THOUGH we have, in a former Part of this Work, given the general Idea of Eclipſes, *Solar* and *Lunar*, from the Principles of PERSPECTIVE; yet as ſome Particulars in regard to Calculation will require to be more minutely conſidered, they ſhall here be propoſed and explained from a Repreſentation different from, but juſt as natural as the other, *viz*, from that which is commonly called HIPPARCHUS's Diagram (Fig. 8.) and uſed by all Aſtronomers.

3927. In this Figure S is the Center of the Sun A B C D; E the Center of the Earth in its Orbit, M the Center of the Moon in *Conjunction*, and N the Moon in Oppoſition. Then becauſe the Moon is an opake Body, it will intercept the Sun Beams, and produce the Shadow Q O G in Form of a Cone.

3928. It is known that the Moon's Diſtance from the Earth is variable, and ſuch, that the Shadow will ſometimes be juſt equal to that Diſtance, then the Shadow's Vertex will juſt touch the Surface of the Earth, as at O, in this Figure, and in this Caſe the Diameter of the Moon Q G will appear to an Eye at O juſt equal to the Diameter A C of the Sun; as they are both ſeen under the ſame Angle A O C. This will produce a *total Occultation* or ECLIPSE of the SUN; but the whole Diſk of the Sun diſappears but for a Moment only, becauſe the Inſtant the Shadow comes upon the Eye, it goes off again.

3929. It is evident, that if the Diſtance of the Moon from the Earth becomes leſs, the Earth will be involved in the dark Shadow Q O G, and the more ſo as the Moon's Diſtance from the Sun is greater, and the Shadow becomes longer. Therefore when the Earth is in its *Aphelion* and the Moon in *Perigee*, the Earth's Surface will receive the Moon's Shadow in the largeſt Quantity it ever can; and this Caſe may be repreſented by Fig. 9. where S C is the Semi-diameter of the Sun, and M G that of the Moon, as before; and M O G the Semi-angle of the Moon's Shadow, which now falls upon the Surface of the Earth B H A in the Quantity B F.

3930. To find the Arch B F, draw M F, E F; then it is plain that the Angle M F G is equal to the Sum of the Angles M O F and F M O (632) therefore O M F = M F G — M O F = *Diff. between the Semi-diameters of the Moon and the Sun.* Then in the Triangle E M K, we have E F to M F (or M B) as the Angle E M F to B E F; but E F and M F are given by the Theory; therefore the Angle B E F or Arch B F is known of courſe; and conſequently how much of the Earth's Surface can be involved in the Moon's dark Shadow.

3931. The Sun will now be not only *totally eclipſed*, but it will continue ſo for ſome time, *viz.* while the Eye of the Spectator paſſes through the Section of the Shadow, or through twice the Arch B F; which Time is readily known from the given Difference of the Diameters of the Moon and Sun, and of their Horary Motions reſpectively.

3932. On the other Hand, when the Lunar Shadow is ſhorteſt of all, and the Moon is the moſt diſtant from the

Earth ſhe can be, that is, when the Earth is *in Perihelio*, and the Moon *New in Apogeo*, with the greateſt Eccentricity, then the Shadow will not reach the Earth; and becauſe in this Caſe (which is exactly the reverſe of the foregoing one) the Moon's Diameter will appear under a leſs Angle than that of the Sun, therefore it *cannot wholly eclipſe the Sun*, but the Sun's Diſk will appear towards the Circumference like a *luminous Ring*, which gives to this Sort of Occultations the Name of *Annular Eclipſes*. But as the Moon's apparent Diameter is ſeldom leſs than that of the Sun, an annular Eclipſe but rarely happens. That to which our Calculations are here adapted (on *Apr.* 1, 1764) is the moſt memorable one in the Annals of Aſtronomy.

3933. In a *Solar Eclipſe*, not the *Dark Shadow* Q O G, but a *Partial* or *Penumbral Shadow* is to be conſidered as the moſt general Cauſe of the Solar *Deliquium*; for the dark or abſolute Shadow produces only the *total Obſcuration*; but all other Phaſes, or Quantities of the Eclipſe, are to be aſcribed to a partial Shadow, or ſuch as cauſes not a Privation but only a Diminution of the Sun's Light to the Spectator.

3934. This is evidently the Caſe of an *Annular Eclipſe*, where there can be no *abſolute Shadow*; but to ſhew the Nature of this Penumbral Shadow more directly, let there be drawn two right Lines A G F and C Q K touching the Sun and Moon on contrary Sides, and interſecting each other in V (Fig. 8.) then there will be formed a Cone K V F ſtanding on the Surface of the Earth from K to F. Then it is evident, that the Eye at K will perceive the Limb of the Moon touching that of the Sun; and the Eclipſe is then and there *beginning*.

3935. As the Spectator's Eye, by the Motion of the Earth, is carried forwards towards the *Solar Meridian* E O, it will view the opake Body of the Moon advancing more and more upon the Sun's Diſk, and thereby diminiſhing its Light by Degrees, till at length being arrived to the dark Shadow Q O G, it will there obſerve the Sun toially obſcured by the dark Moon, and that will be the Middle of the Eclipſe. All the ſame Phaſes will appear on the other Side, till the Eclipſe ends at F.

In order to calculate the Extent or Magnitude of this *Penumbra* upon the Surface of the Earth, you proceed thus; draw the Line SQ, and in the oblique Triangle QVS the external Angle $QVM = VQS + QSV$, but the Angle QSV or QSM ($=$ *Moon's Apparent Semi-diameter* at the Sun) is inſenſibly ſmall; whence the Angle $QVM = VQS$ or SQC the Apparent Semi-diameter of the Sun. Alſo in the oblique Triangle OQS, the external Angle $AQS = QOS + OSQ$, which latter OSQ is inſenſible; therefore $ASQ = QOS$ or AOS; hence it follows that the Angle $QVM = QOM$, and conſequently that the Cone $QVG =$ Cone QOG of the dark Shadow.

3937. Again, Let ab be a Section of the *Penumbra* by the Surface of the Earth, and draw Mb; then is OMb or cMb the Semi-angle of the Penumbra on the Earth as viewed from the Moon M. But this Angle cMb is the external Angle of the oblique Triangle VMb; therefore $cMb = MbV + MVb$; that is, *the Semi-diameter of the Penumbra is equal to the Sum of the Semi-diameters of the Moon and the Sun.*

3938. Laſtly, draw EF; then in the Triangle EMF we have EF to MF (or MO), as the Angle EMF to the Angle MEF or OEF which gives the Arch OF for the *abſolute Meaſure or Extent of the Semi-diameter of the Penumbra on the Surface of the Earth.*

3939. With regard to *Lunar Eclipſes*, we have need only to compute the Semi-angle EPH of the Earth's Shadow, and its Dimenſions ND in that Part where the Moon paſſes through it in the Eclipſe. In the oblique Triangle PHS (Fig. 9.) the external Angle $SHC = HPS + HSP$; but HSP or HSE is the Sun's Parallax, and ſo not ſenſible; *therefore the Angle* $EPH = SHC =$ *Sun's Semi-diameter.*

Hence it appears *that the Terreſtrial and Lunar Shadews are ſimilar Cones*, ſince the vertical Angles are equal.

3940. Then, in the oblique Triangle P N H, the external Angle E N H = N P H + N H P, and therefore N H P or N H D = E N H − N P H; that is; *the Apparent Semi-diameter of the Earth's Shadow, at the Diſtance of the Moon, is equal to the Difference between the Moon's Horizontal Parallax and the Apparent Semi-diameter of the Sun.*

CHAP. XI.

An APPLICATION of the foregoing PRINCIPLES in the DELINEATION and CONSTRUCTION of LUNAR and SOLAR ECLIPSES.

3941. TO delineate an ECLIPSE of the MOON will require but little Time and Trouble when from the Tables you have obtained her Place, and all the other Pre-requiſites; for then you draw a Line A B to repreſent the *Ecliptic*, and another D C for the Moon's *Viſible Path* (3921) inclined to the Ecliptic in its proper Angle (3922) and interſecting it in the Point N. See Fig. 10.

3942. Then from the known Diameter of the Sun and Moon's Horizontal Parallax, you find the Semi-diameter of the Earth's *dark Shadow* (3940). With this you deſcribe ſeveral Circles in and near the Node N, as at N, I, H, &c. and having deeply ſhaded them, they will very truly repreſent the Section of the Earth's real Shadow, at the Diſtance of the Full Moon, on the oppoſite Side of her Orbit.

3943. Now let M be the *Full Moon*, and it is evident there is a certain Point as H where the Latitude of the Moon H M is juſt equal to the *Sum of the Semi-diameters* of the *Moon*

Moon and Shadow, that is, where the Limb of the Moon will juſt touch the ſhadowy Cone in E, but not enter it; and this Diſtance H N from the Node is called the *Ecliptic Limit*, becauſe beyond the ſaid Point H from N there can be no Eclipſe.

3944. If the Moon be within this Limit any-where as at L, then the Earth's Shadow, paſſing by, will involve her illumined Diſk more or leſs, and ſo produce an ECLIPSE. You find the neareſt Diſtance of the Centers I L at the Time of the OPPOSITION, and then on the Centers I and L deſcribe Circles with the known Semi-diameters of the Shadow and Moon, and you will have the *Phaſe* or *Quantity* of the Eclipſe very lively delineated.

3945. In this Caſe of the Moon immerſed in the Shadow, let P Q be her Diameter, and P O the Part thereof in the Shadow. Then put $A =$ Semi-diameter of the Shadow, $B =$ the Semi-diameter of the Moon; $N =$ the neareſt Diſtance of the Centers I L; and $D = OP$, the Part of the Diameter eclipſed; then 'tis plain from the Figure that $N - B = A - D$, and conſequently the Part eclipſed will always be $D = A + B - N$. Hence when $D = 0$, then $N = A + B$, as at the Limit H. When $D = B$, then $N = A$; and when $D = 2B$, then $N = A - B$, or the Moon is wholly immerſed in the Shadow.

3946. It is further evident, that the Moon at G or F ſhews the *Beginning* and *End* of the Eclipſe; and in the right-angled Triangle I L G the Side I L and I G being known by the Theory, you have the Side G L; the Time of paſſing, which is given from the Hourly Motion of the Moon in the Tables; and conſequently, the Time of the *Beginning*, *Middle*, and *End* of an ECLIPSE of the MOON, together with the Quantity thereof, are all known with little or no Labour.

3947. When the *Oppoſition* happens in the *Node* itſelf, as at N, the Moon is then *centrally* eclipſed, and ſhe deſcribes a whole Diameter of the Earth's Shadow in paſſing through it; conſequently the *Duration* of ſuch an *Eclipſe* is the greateſt of all others. The Shadow of the Earth is far from being abſolutely dark, for by the Atmoſphere about it there is a great deal of Light refracted into the ſhadowy Cone, and particularly about that Part where the Moon paſſes through it, which is the Reaſon why ſhe is ſeen ſo plainly in the Midſt of the Shadow.

3948. The THEORY or *Rationale* of a *Terreſtrial* ECLIPSE is much the ſame; for the *Lunarians* (if any) ſee the Shadow of their Globe paſs over the Surface or Diſk of our Earth juſt in the ſame Manner as we view them eclipſed in our Shadow; with this Difference, that we ſee their Globe much leſs than the Terreſtrial Shadow, and they ſee our illumined Diſk much larger than even their Penumbral Shadow, and therefore a *Terreſtrial* ECLIPSE can only be *Partial*, even when it is *Central*.

3949. The Dignity of this Subject demands an ample Illuſtration; therefore a large Copper Plate is beſtowed wholly upon it (See Plate II.) In this the *enlightened* Diſk of the EARTH (as ſeen from the *Moon*) is repreſented with all its *Hour-Circles orthographically projected*, the univerſal Meridian paſſing through the Center C, in Form of a right Line, in which the North Pole of the World is denoted by P, juſt within the Diſk, at the Time of the Eclipſe under Conſideration.

3950. In this Projection, E C L is the *Ecliptic*, C I is the *Solar Meridian*, in which C H is the *Latitude* of the Moon, and A D the Path of the *Lunar Shadow* over the Earth, making the required Angle with the Ecliptic, which is equal to the Angle H C B (3923) and therefore C B is the *neareſt Diſtance* of the Centers of the Earth and Shadow. If from the Horiz. Parallax of the Moon 54′ 10″, we deduct the Sun's Parallax 10″, we ſhall have the Semi-diameter of the Diſk C F = C O = 54′.

3951. The Sum of the Semi-diameters of the Sun and Moon is = 16′ 2″ + 14′ 38″ = 30′ 40″, which add to the

Semi-diameter of the Diſk 54, the Sum is $84' \, 40''$; with this Diſtance taken in the Compaſſes from the *Scale of* MINUTES (at the Bottom of the Plate) if you place one Foot in C, the other will reach to A and D in the Line of the Shadow's Center, and there making Marks, draw A C and D C. Then taking $30' \, 40''$ from the ſame Scale, and upon the Points A, B, D, as Centers deſcribe Circles; theſe will repreſent the *Penumbral* SHADOW of the MOON in its proper Poſition, at the *Beginning*, *Middle*, and *End* of the *Terreſtrial* ECLIPSE, as is evident from the Theory (3937, *&c.*)

3952. If a Line M N be drawn acroſs the Diſk to touch theſe Penumbral Circles, it will cut off that Segment W I Y T W which was involved in the Penumbra, or in which the Inhabitants of the Earth could perceive any *Occultation of the Sun.* In the Poſition of the *Penumbra* at B, it is in its greateſt Quantity upon the Diſk, being near ¾ of its Diameter, the reſt falls off the Earth northwards into the dark *Inane.*

3953. The Angle $BCH = 5^\circ \, 25'$, as was ſhewn (3922) and the Side $CH = 39' \, 46'' = 39'',75$; then in the right-angled Triangle H B C, you find the Side $BH = 3',75$, and the Side $CB = 39',6$. Then in the right-angled Triangle A B C, there are known the two Sides B C and A C (3951). Whence you find the Angle $CAB = 27^\circ \, 53' = CDB$; and the Angle $BCA = 62^\circ \, 07' = BCD$. And thus the *Angles of Incidence and Emerſion* of the Penumbra on the Earth's Diſk are known.

3954. In the ſame Manner the ſame Angles are found for the Center of the dark Shadow at G and F, for in the Triangle C B G, the Sides C B and C G are known, therefore you find the Angle $CGB = 47^\circ \, 10' = CFB$. And the Angle $BCG = 42^\circ \, 50' = BCF$. Alſo in the Triangle ABC, we find the Side $AB = 75' = BF$; and in the Triangle B C G we find the Side $GB = 36' = BF$.

3955. To find the Middle Moment of the Eclipſe, *viz.* when the Center of the Shadow is at B, ſay, As the Hor. Motion of the Moon from the Sun 27′,18 is to 60′, ſo is 3′,75 to 8′ 16″, which is the Time of the Shadow's paſſing over BH; then from the Time of the Conjunction 23′ 9″ ſubtract 8° 16′, and there will remain 10^h 14′ 53″ for the *Middle Moment of the Terrreſtrial* ECLIPSE.

3956. Then for the *Beginning* and *End*, ſay, As 27′,18 is to 60′, ſo is 75′ = AB to 166′ = 2^h 46′, which ſubducted from 10^h 14′ 53″ leaves 7^h 28′ 53″ for the Time in the *Morning* when the Eclipſe began; or the *Penumbra* firſt touched the Earth at O. Alſo to the Middle Moment add 2^h 46′, and the Sum 1^h 00′ 53″ is the Time in the Afternoon when the *Penumbra* left the Diſk at K, or the *Eclipſe ended*. So that the *whole Duration of the Eclipſe was* 5 *Hours and* 32 *Minutes*.

3957. Hence alſo the Time is found when the Center of the *Penumbra* touched the Diſk at G, and went off at F, by ſaying 27,18 : 60′ : : 36,′6 (= GB) : 81′ = 1^h : 21′, which taken from 10^h 14′ 53″, leaves 8^h 53′ 53″, the *Beginning* of the *Central Eclipſe*; and their Sum is 11^h 35′ 53″, the *Time of the End thereof*. So that the Center of the *Penumbra* was upon the Earth 2^h 42′.

CHAP. XII.

The CONSTRUCTION of the PHASES of a *Solar* ECLIPSE, by PROJECTION, for any particular PLACE,

3958. HAVING delivered the Principles of a *Lunar* and *Terreſtrial* ECLIPSE, we now proceed to ſhew how the *Phænomena* or *Phaſes* of an *Occultation* of the

SUN may be conſtructed, and truly repreſented for any particular Place, as LONDON, for Example. It is ſuppoſed the young Aſtronomer underſtands the *Orthographical* PROJECTION *of the* SPHERE, the Principles of which have been delivered in a former Part of this Work (1703, &c.)

3959. Therefore having projected the Hour Circles on the Earth's Diſk, and the *Parallel* of *London*; let that *Parallel* be properly divided into *Hours*, *Quarters*, and *Minutes*; for which the Radius of the Diſk ought not to be leſs than 15 or 18 Inches.

3960. Then the PATH of the SHADOW muſt likewiſe be divided into Hours and Minutes, as is very eaſily done from the above *Data*. For ſince the Center of the Shadow is at B at 10^{h} 14′ 53″, therefore ſay, As 60′ is to 27,18, ſo is 14′ 53″ to 6,75 = Diſtance from B to X; the Point for the Hour of X being known, you take 27,18 from the Scale of Minutes in the Compaſſes, and ſet it off from X each Way to XI, XII, I, on the right hand, and to IX, VIII, *&c.* on the left. Thus the Line AD is divided into Hours, and each Hour being ſubdivided into 60 equal Parts, will be the Minutes required.

3957. Then ſince the Eye of a Spectator at *London* is in the Parallel, and in that very Point which denotes the given Time, and the Sun's Center and Spectator's Eye are mutually the ſame Point on the Diſk; therefore, if with the Semi-diameter of the Sun 16′ 2″, and one Foot of the Compaſſes on a given Minute in the Parallel, you deſcribe a Circle that will repreſent the Sun's bright Diſk; and then taking 14′ 38″ the Moon's apparent Semi-diameter, and with one Foot of the Compaſſes placed in the ſame Minute of the Shadow's Path, you deſcribe another Circle, this ſhall be the dark Diſk of the Moon; and thus it will appear how they are poſited and related to each other at that given Minute, or Inſtant of Time.

3958. For if theſe Circles are at any Diſtance, the Eclipſe is either not begun, or it is over; if the Circles juſt touch each other, it ſhews the *Beginning* or *End* of the *Occultation*; and if the Circle of the Lunar Diſk falls over any Part of the *Solar Circle*, it ſhews the *Obſcuration* or *Eclipſe*, the *Phaſe*, and the *Quantity* of it.

3959. Having the *Data* for this Eclipſe from Mr. CLAIRAUT's Tables, it will be eaſy to ſhew how exact theſe Tables are, by comparing the obſerved Times of the *Beginning*, *Middle*, and *End* thereof at LONDON, with thoſe given by Projection from the ſaid Data of the Tables. Thus from the Scale of Minutes take off 30′ 40″, which is the Sum of the Semidiameters of the Sun and Moon, and carry the Points of the Compaſſes in ſuch Manner over the Minutes of the Parallel and Shadow's Path, till they fall upon the ſame Minute in each on both Sides of their Interſection, and you will find the Coincidence on the left Hand, for the Beginning of the Eclipſe in the Morning will be at 9 h 4′ 30″; and for the *End* in the Afternoon, the Points will fall on 12 h 3′ 30″ in each; which Points if on Arches of Circles a e b and d e c be deſcribed, they will mutually touch in e, and ſhew the BEGINNING; as two others, m q n and p q o will, by their Contact in q, ſhew the END of the Occultation at LONDON.

3960. To find the Time of the *Greateſt Obſcuration* or Middle of the Eclipſe at *London*, obſerve very nicely with the Points of the Compaſſes what *two Points denoting the ſame Inſtant of Time* in the *Parallel* and *Lunar Paths* are neareſt together of all others, which you will find to be between the 29th and 30th Minute after 10 in each; but neareſt the latter; therefore the *Middle Moment of the Eclipſe* was at 10 h 29′ 35″.

3961. As I had the Honour to wait on the Right Hon. the EARL of DELAWAR, and other Noblemen and Gentlemen, at his Houſe in *Hanover-ſquare*, to repreſent the Phaſes of this Eclipſe through a *Reflecting Teleſcope*, which formed the *Phæno-*

Phænomenon on a large Sheet of Paſteboard properly inclined, and fixed for taking Meaſures; I had the Opportunity of obſerving the Beginning of the Eclipſe, and alſo to be pretty certain of the Time when it ended (though that could not be ſeen) and theſe Moments were nearly the ſame as thoſe above aſſigned from the Theory; and theſe Times of the Phaſes have alſo been confirmed by others, who had the Advantage of a clearer Air to make their Obſervations on them more accurately.

3962. But with regard to the *Quantity of the Phaſes*, particularly that of the *Creſcent*, in the Middle of the Eclipſe, there was not the ſame Agreement between the Theory and Obſervations; for by meaſuring the wideſt Part of the Creſcent very carefully and often, about the Time of its being largeſt, and likewiſe the Diſtance and Poſition of the *Cuſpides*, I found that from the Reſult of them all, the Breadth of the Creſcent, in the wideſt Part when a *Maximum*, did very little exceed a *Twelfth Part* of the *Sun's Diameter*, or that it was very near 2′ 45″ when meaſured on a proper *Scale of Digits*.

3963. Now this differs much from what we collect from the THEORY, and by a large PROJECTION; and therefore it will be neceſſary to be very exact in repreſenting and inquiring into the Cauſes thereof. For let S be the Center of the *Sun's Diſk a e c f* (Fig. 1. Plate III.) M that of the *Moon's Diſk b e d f*; then by the Projection the Diſtance S M of the Center in the greateſt Obſcuration was 1′ 45″; this added to $Sa = 16' \, 2''$ gives $Ma = 17' \, 47''$; from this take $Mb = 14' \, 38''$, and there will remain $ab = 3' \, 9''$ = to the Breadth of the Creſcent, which, inſtead of being $\frac{1}{12}$ of $ac = 32' \, 4''$, is more than a $\frac{1}{11}$ Part.

3964. In this great Difference the *Aſtronomical Tables* have no Share; for the Theory of the Earth's Motion is ſo well known, that the *Sun's Apparent Diameter* is at any Time or Diſtance known; and is the ſame within a few Seconds in all the Tables extant of late Publications. Thus for the preſent Anomaly 9^s 1° 23′ (3907) we have the Sun's Apparent Diameter in the Tables by

	′	″
Dr. HALLEY - - -	32	9
CASSINI - - -	32	6
DE LA CAILLE - -	32	4
MAYER - - -	32	4

3965. The Moon's Apparent Diameter is indeed a little uncertain, as we do not know the true Proportion of her Magnitude to that of the Earth; by the lateſt Diſcoveries it ſhould be that mentioned in (3914) which makes the Lunar Semi-diameter for her preſent Horizontal Parallax but 14′ 38″. Mr. *De la Caille*'s Ratio of 55 $\frac{7}{10}$ to 15 (in his *Aſtronomy*, Page 300) makes it ſtill leſs. If we take it from Tables that make it largeſt of all, *viz.* 14′ 46″, or 14′ 48″, it will avail us little, for 14′ 47″ will give the Width of the Creſcent at *a b* full 3′, exceeding the ſame by Obſervation by 15″ (3992).

3966. The Cauſe of this Difference is therefore not in the Aſtronomical Elements of the Theory, but undoubtedly in the Earth itſelf. Had we beheld this *Phænomenon* from the Surface of a *truly Spherical Earth*, it would have had nearly the Phaſes of the Theory; but being ſeen from an oblate Spheroid, thoſe Phaſes muſt neceſſarily change, and become what we obſerved them; and as it is a Matter of the higheſt Importance to demonſtrate the Conſequence of Effects from their genuine Cauſes, and to reconcile the Diffferences that may ariſe between them and the Theory, I ſhall employ the two following Chapters for this Purpoſe, eſpecially as our Books of Aſtronomy are almoſt ſilent in ſo intereſting an Affair.

CHAP.

CHAP. XIII.

Of the true FIGURE of the EARTH, and ſuch Calculations as are neceſſary for reducing the SPHERE to the SPHEROID, for ſolving the PHÆNOMENA of ECLIPSES.

3967. AS the FIGURE of the EARTH is a Point of the higheſt Conſideration in all *Aſtronomical*, *Geographical*, and *Nautical* Calculations, it will be neceſſary, in a Work of this Kind, to lay down a few Principles and Methods of Computation relative thereto; eſpecially ſince if the Figure of the Earth deviates ever ſo little from that of a *Sphere* towards an *oblate or flatted Spheroid*, there will ariſe ſome ſmall Differences in the *Quantity and Times* of the *Phaſes* of ECLIPSES, as they are computed from TABLES, which can only adequately anſwer to the *Figure* of a real GLOBE, as we obſerved (3966).

3968. This Doctrine has been largely treated of in a former Part of this Work (from 3370 to 3391.) with reſpect to the *Phyſical Cauſe*; therefore what we have now to do is, to ſhew how the Effects ariſing from thence, which concern the Doctrine of Eclipſes, may be computed, and a proper Eſtimate made thereof, and Allowance for them, in all Phænomena of this Kind.

3969. For this Purpoſe, let E P Q be a *Circle*, and E p Q an *Ellipſis* generating the *Sphere* and *Spheroid* upon the Diameter E Q. Then with regard to our Earth, let E Q be the Diameter of the *Equator*, and P C the Semi-Axis of diurnal Rotation in the Sphere, and p C that of the Spheroid; then are P and p the Poles in each, and we have ſhewn (3385) that $CP : Cp :: 266 : 264,7$, and therefore putting $CP = 1$, we have $Pp = \frac{1}{266} = 0,00376$. (See Fig. 2. Plate III.)

3970.

3970. But in Caſe of Eclipſes, the Radius of the Earth's Diſk $CE = CP = 54' = 3240''$; and we have $Pp = 12',2$. Let G F be the Path of the Shadow, then will the Center of the Shadow emerge from the *Spheroid* at T, and from the *Sphere* at F; then by finding D F we ſhall have the Difference in Time of the End of the Central Eclipſe on the *Spheroid* and *Sphere*.

3971. In order to this, we find the Angle $ICP = 23°$, by knowing the Sun's Declination and Obliquity of the Ecliptic at the Time of the Eclipſe. Thence is found the Angle $BCP = 28° \ 25'$ (See Plate II.) which taken from $BCF = 42° \ 50'$ (3954) there will remain $PCF = 14° \ 25'$, the Complement of which is $FCQ = 75° \ 35'$, which is the Latitude of the Point F.

3972. From F let fall the Perpendicular F N (which will be the Sine of QF) cutting the Ellipſe in H, then from the Equation of the Curve (767) we ſhall have $CP : FN :: Pp : FH$; that is, as Radius (r) : Sine (s) of QF, ſo is $Pp = 12'',2$ to $FH = 11'',8$.

3973. Then becauſe of ſimilar Triangles F C N, and F H B, we have $CF : FN :: r : s :: FH : FB = 11,54$. Hence, by the way, it appears that Pp, FH, FB, are in *Geometrical Proportion*.

3974. Laſtly, In the right-angled Triangle F B T there are known the Side F B and the Angle B F T (3954) to find the Hypothenuſe T F; thus the Sine of the Angle $BTF = 42° \ 50'$ is to Radius, as $FB = 11'',54$ is to $FT = 17''$, *ferè*. Then becauſe the Moon's hourly Motion is $27',18$ or $1631''$ in $3600''$ of Time; therefore ſay, As $1631'' : 3600'' :: 17'' : 37''\frac{1}{2}$ of Time, which is the Difference between the Times of the End of the Eclipſe on the *Spheroid* and *Sphere*.

3975. If the ſame Calculation be made for the Beginning of the Central Eclipſe at G, you will then have the whole Difference in the Duration of the Central Eclipſe, which will be about $\frac{1}{4}$ of a Minute leſs on the *Spheroid* than on the *Sphere.*

3976. The better to judge how this *Spheroidal Figure* of the Earth affects the Phænomena of the *Solar Obſcuration* for any particular Place, we muſt find the Poſition of the Parallel of that Place both on the *Sphere and Spheroid*, and then we can delineate the Aſpects or Phaſes of the Luminaries from each, and conſequently be informed of their Difference both in regard to *Quantity and Time.*

3977. Thus, for Example, let L Q be the Latitude of LONDON, and its Parallel is drawn on the *Spherical* Diſk by the uſual Rules of the *Orthographical Projection*; but to lay down the ſame Parallel on the Diſk of the *Spheroid*, we muſt find the Diſtance between each as follows: Draw the Radius C L, and the Sine L R, cutting the Ellipſis in e and g; then make $gD = ge$, and draw D W parallel to C L, and it will be perpendicular to the Ellipſis in D, therefore the Point D on the Spheroid has the ſame Latitude as L on the *Sphere*, becauſe of the Angle $DWQ = LCQ$. Laſtly, parallel to C Q draw D M cutting the Line L R in O, then is L O the Diſtance between the Parallels to be found.

3978. To effect this, ſay, As Radius (r) is to the Sine (s) of 51° 30′ (the Lat. of *London*) ſo is $Pp = 12'',2$ to $Lg = 9'',55$. Again, $Pp : Lg :: Lg : Le \doteq 7'',5$ nearly. In the ſimilar Triangles CgR and Lgd, we have $Cg : CR ::$ Radius (r) to the Coſine of L $(c) :: Lg : Ld = 6''$ nearly; but $Ld \doteq eg$; and by the ſimilar Triangles egL and DgO we have $Lg : ge :: gD : gO = 3'',72$. Then $Lg + gO = 9,55 + 3,72 = 13'',27 \doteq LO$, *the Diſtance of the Parallels on the Sphere and Spheroid*, as required.

3979. But to have ſtill a better Idea of this Affair, let us ſee how many Seconds of a Minute on the Diſk one whole Degree occupies in our Latitude. Thus, As Radius is to the Sine of 52°, ſo is 3240″ (the Seconds in the Radius of the Diſk) to 2559″; and Rad. : Sine of 51° :: 3240″ : 2519″; therefore one Degree = 40″; hence the Diſtance of the two Parallels 13″,27 is very nigh $\frac{1}{3}$ of a Degree, or we are 23 *Engliſh Miles nearer to the Equator on the Spheroid than on the Sphere.* From hence alſo it appears, that *two Engliſh Miles* nearly correſpond to a *Second of a Minute* on the Earth's Diſk with us.

3980. This Figure of the *Spheroid* and *Sphere* will afford many other curious Inveſtigations relative to the *True Dimenſions* of the EARTH, the *Direction* of GRAVITY, the *Lunar Horizontal* PARALLAXES, *&c.* But as theſe great Points are not immediately connected with the Doctrine of Eclipſes further than they have been already conſidered, I ſhall conclude with only one Obſervation more, *viz.* That ſince it is well known, that in the Latitude of 54° 44′ *a Degree of the Spheroid is equal to a Degree of the Sphere under Conſideration*; therefore the Convexity of the Spheroid in the Latitude of *London* is very little different from that of the *Sphere*, and conſequently *the Dimenſions of the Shadow upon each will be very nearly the ſame.* What theſe are, will be the Subject of our next Inquiry.

CHAP. XIV.

Of the FORM and DIMENSIONS of the *Dark* SHADOW on the SURFACE of the EARTH, conſidered both as a SPHERE and SPHEROID, with a *Geographical* DELINEATION thereof for ENGLAND, FRANCE, *&c.*

3981. BY the foregoing Calculations it ſufficiently appears how far the Phænomena of Eclipſes (eſpecially thoſe of the Sun) are concerned and affected by the Figure of the Earth; it is eaſy from thence to obſerve, that the *Spheroid* will alter their Phaſes on a double Account; for (1) As the Earth becomes flatted in the Northern Parts, the Shadow will extend to greater Northern Latitudes than it could do on the *Spherical Earth*. And (2) The ſame Place (as LONDON) will upon the flatted Spheroid be brought nearer to the Equator (3979) and conſequently nearer to the Shadow in Eclipſes.

3982. But in order to a further Illuſtration of this Subject, we ſhall treat more particularly of the Doctrine of Shadows, and ſhew how their Dimenſions may be eaſily eſtimated in every reſpect upon the Surface of a Sphere, and then afterwards how they are reduced and eſtimated on the Surface of our Earth, conſidered as a *Spheroid*. To this End, let *o d* (Fig. 3.) be a Part of the Circumference of the Earth's Diſk, whoſe Center is at S; and let K L M N be Part of the Path of the Shadow over it, and A C B D the Shadow itſelf in any particular or given Poſition.

3983. It is now, in the Firſt Place, eaſy to conceive that the Section of the Lunar Shadow by a perpendicular Plane, as that of the Earth's Diſk, will be a *Circle* as here repreſented, whoſe Dimenſions are calculated as before directed (3979).

3984. But the Interſection of the ſhadowy Cone by the *convex ſpherical Surface* of the Earth is not a *Circle*, but an *Oval*, nearly approaching to an *Ellipſis*, and whoſe ſeveral Dimenſions are now to be eſtimated or meaſured. In order to this, let A C B D be a circular Section of the Shadow juſt at the Surface of the Earth, and it will be parallel to the Plane of the Diſk. Then let S l be the Projection of a *Vertical Circle* paſſing through the Center of the Shadow, and draw A *a*, B *b* parallel to S I, then will *a b* be the Arch of a Circle, which, when meaſured in Degrees and Minutes, will ſhew the *leaſt Diameter* of the *ſhadowy Oval* on the Earth's Surface.

3985. It is farther to be obſerved, that this leaſt Diameter of the Oval is conſtant, or the ſame, on every Part of the Surface in its Paſſage over it; thus at P, by drawing S *p* thro' the Center, and O *o*, Q *q*, parallel thereto, the Arch *o q* = *a b*; and ſo it will be every-where.

3986. To find and eſtimate the longeſt Diameter of the Oval, let C *c* and D *d* be drawn perpendicular to S I; then from the Nature of the Projection we have I *c* = I C, and I *d* = I D, and conſequently, *d c* will be the Meaſure of the *Length of the oval Shadow* on the Vertical Circle S I; which therefore, it is plain, will be the longeſt of all on the Earth's Surface. It is alſo eaſy to conceive that this longeſt Diameter is every-where variable, and its Limits eaſy to aſſign.

3987. As two parallel Circles upon a Globe include a Zone or Space every-where of an equal Breadth, ſo the two Lines K M, L N, may be conſidered as the Projections of two ſuch Parallels, and they will include that Part of the Earth's Surface over which the elliptic Shadow paſſes; and conſequently it muſt appear, that that Tract of the Earth is a *Zone of an equal Breadth*, and is deſcribed by ſuch a Diameter of the Shadow as is meaſured by the Arch *g h*.

3988. It is further evident that this conſtant Diameter *g h*, or Breadth of the ſhaded Zone, will ever be greater than the leaſt Diameter *a b* of the *Oval Shadow*; but always leſs than its greateſt Diameter *c d*, except in one Caſe, *viz.* when the Shadow is at K L, where S L is perpendicular to the Path, for then *c d* coincides with *g h*, and is equal to it; which therefore is in the Middle Moment of the general Eclipſe.

3989. Laſtly, If we make E *e* and E *f* perpendicular to the Path, they will include the Arch *e f*, which will meaſure that Diameter of the Oval which is perpendicular to that of its Breadth. This will be every-where variable, and equal to the ſhorteſt Diameter *a b* in the Middle of the Eclipſe at K.

3990. Hence, either by Calculation or Projection, the Value of theſe ſeveral Diameters may be accurately obtained in

Numbers. For Example, If we ſuppoſe the Apparent Semi-diameter of the Moon (according to MAYER's Table thereof) to be 14′ 46″, then this being taken from the Sun's Semi-diameter 16′ 2″, leaves 1′ 16″ = 76″, the Semi-diameter of the Shadow (3930). Hence the leaſt Diameter of the Shadow is $ab = 152''$; the greateſt Diameter $cd = 229''$; and the Breadth of the Shadow $gh = 224''$.

3991. It remains now to give a *Geographical* DELINEATION of this ECLIPSE, as it was found by Experiment to happen on the *Spheroid* or real Earth, and then we ſhall eaſily ſee the Reaſon why the Phænomena by the Theory ſhould be ſo different from thoſe which were really obſerved. For this Purpoſe a Map of the Paſſage of the Shadow over the *South-Eaſt* Parts of ENGLAND, the CHANEL, Coaſts of FRANCE, FLANDERS, *German* OCEAN, *&c.* will be ſufficient for a thorough Elucidation of this Affair (See Fig. 4.)

3992. The firſt Thing to be determined in the Conſtruction of ſuch a Map was, the Vicinity or Diſtance of the *North-weſt Limit*, or Line G H, of the Shadow, from the Metropolis of LONDON; and alſo its Poſition in regard to the Meridian. To aſcertaint he firſt of theſe Points (as I had then an Undertaking of this Nature in View) I ſent my Son in Company with a Gentleman to ROCHESTER, on the Morning of that Day, to obſerve the Phaſes of the Eclipſe there; which they did, in Company with many of the principal Gentlemen of the City, with a Variety of Glaſſes; and they all unanimouſly agreed, that not the leaſt Glimpſe of the Sun's lower Limb appeared at the Time of the greateſt Obſcurity. This demonſtrated *that the Diſtance of the Shadow from* LONDON *a little exceeded the Diſtance of the City of* ROCHESTER.

3993. That the Shadow was very near to *Rocheſter* is certain, becauſe ſeveral Gentlemen at *Canterbury*, but eſpecially at *Dover* and *Hythe*, ſaw the *Annulus* ſo plainly and completely, that they could ſcarcely obſerve (with ſmoaked Glaſſes) any Difference in the Breadth of the upper and lower Parts thereof.

of. Therefore the *Shadow's Proximity to London* is ſettled beyond Diſpute *.

3994. The ſecond Thing was, to determine the DIRECTION *of the Shadow* with reſpect to the MERIDIAN of LONDON. This I attempted two Ways, *viz.* by a large *Projection*, and alſo by actually drawing the Path of the Shadow on the Surface of a large Terreſtrial Globe properly rectified for the Purpoſe. And by repeated Meaſures of the *Angle of Poſition* both Ways, the Reſult gave it 34° 30′, and ſuch therefore is the Angle which the Line G H makes with the Meridian of *London*.

3995. Having thus determined the Direction of the Shadow, its Poſition and Delineation is then very eaſy, as alſo to find its Magnitude in every Part, *viz.* by making the ſhorteſt Diameter $QR = 152''$, the longeſt $OP = 229''$, and the Breadth of the Shadow $ST = 224$, from the Scale of Minutes, which may be ſo contrived, and diagonally divided, as to give the Length of thoſe Lines to a *Second*.

3996. By the Meaſures of the *Creſcent* in the wideſt Part ab (Fig. 1. it was found to exceed a very ſmall Matter *one Digit*, or $\frac{1}{12}$ Part of the Sun's Diameter. Now let $ab = 2'\ 40''$ = one Digit exactly; then will the *eleven Digits* $bc = 29'\ 24''$ taken from the Moon's Diameter $bd = 29'\ 32''$ leave $cd = 8''$, which therefore muſt be the Diſtance of the Line of 11 Digits F E from the Limit of the Shadow G H; but this is about 15 Miles (3979) or half the Diſtance from *London to Rocheſter*; and therefore at *London* the Sun's Creſcent appeared about 2′ 48″ when of the leaſt Breadth.

3997. If then from the Sun's Semi-diameter $Sa = 16'\ 2''$ you take $ab = 2'\ 48''$, there will remain $Sb = 13'\ 14''$, which take from the Moon's Semi-diameter Mb, there will remain $SM = 1'\ 32''$ for the Diſtance of the Centers of the Sun and Moon as ſeen from *London*.

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* In the laſt vol. of the Tranſactions there is an Account of Mr. *M. Murray*'s viewing the Eclipſe at *Chatham* with a 12 Feet Teleſcope, through which, he ſays, he ſaw the Sun's lower Limb, and the Part of the Annulus there, as fine as a Hair. Hence the Line or Limit G H undoubtedly paſſed through *Chatham*, as here repreſented in the Map.

3998. All theſe Circumſtances of the Eclipſe obſerved from the Earth, as a real *Ellipſoid*, are, we ſee, widely different from thoſe which are derived from the Theory for a ſpherical Earth; and all evidently owing to what we demonſtrated (3978) *viz. That the Parallel of* London *on the Earth is nearer to the Shadow by* $\frac{1}{3}$ *Part of a Degree than the Parallel of the ſame Latitude on the Sphere.* Therefore if we conceive the oblate Spheroid of the Earth to expand itſelf into a perfect Sphere whoſe Axis is equal to the Diameter of its Equator, then will the preſent Parallel of *London* A B be carried northward to C D, and the City of *London* to the Point L.

3999. Hence the Inhabitants of *London* at L, being removed farther from the Shadow, would ſee the Creſcent in the Middle of the Eclipſe much broader, *viz.* 3′ (3965) they would ſee the Moon's Center more diſtant from the Sun's, *viz.* about 2′ 45″ (3962). In ſhort, all the Phaſes of the Eclipſe would in ſuch a Caſe have appeared to us at L, much the ſame as they now appeared to the Inhabitants of the Town of *Hertford*.

4000. Add to this, that by ſuch an Expanſion of the Northern Parts our Earth in the Counties of ESSEX, SUFFOLK, and NORFOLK, would have been carried quite out of the Shadow, and only the *Iſle of Thanet*, and Southern Part of KENT and SUSSEX, of all GREAT BRITAIN, would have ſeen the *Annulus* at all.

4001. The following Table was forgot to be inſerted in its proper Place (at Page XVI) and therefore we give it a Place here. It was computed by the celebrated *Mayer*, from a great Number of Obſervations made on purpoſe to determine the Ratio of the Moon's *Equatorial Diameter* to her *Horizontal Parallax*, which at length he found to be very preciſely as 30′ to 55′ 2″; and from that Ratio he conſtructed this Table, which ſhews her Diameter for any given Horizontal Parallax corrected. The above Proportion is alſo verified by actual Meaſures made of the Moon's Diameter whilſt ſhe was on the Sun's Diſk, *viz.* by Mr. Bliss it was found (from a Mean of ſeveral) to be 29′ 45″,1; but this being on the Earth's Surface at an Altitude of 39°, will be about 18″ larger than if ſeen from the Center; whence her Diameter will be at the Time of the Eclipſe 29′ 27″,5, ſcarce 5″ different from Mr. *Mayer's*, which therefore may be deſervedly eſteemed the moſt exact of any extant.

TABLE X.

Parall.	Diam.	Parall.	Diam.
′ ″	′ ″	′ ″	′ ″
54 . 5	29 . 30	57 . 56	31 . 36
54 . 16	29 . 36	58 . 7	31 . 42
54 . 27	29 . 42	58 . 18	31 . 48
54 . 38	29 . 48	58 . 29	31 . 54
54 . 49	29 . 54	58 . 40	32 . 0
55 . 0	30 . 0	58 . 51	32 . 6
55 . 11	30 . 6	59 . 2	32 . 12
55 . 22	30 . 12	59 . 13	32 . 18
55 . 33	30 . 18	59 . 24	32 . 24
55 . 44	30 . 24	59 . 35	32 . 30
55 . 55	30 . 30	59 . 46	32 . 36
56 . 6	30 . 36	59 . 57	32 . 42
56 . 17	30 . 42	60 . 8	32 . 48
56 . 28	30 . 48	60 . 19	32 . 54
56 . 39	30 . 54	60 . 30	33 . 0
56 . 50	31 . 0	60 . 41	33 . 6
57 . 1	31 . 6	60 . 52	33 . 12
57 . 12	31 . 12	61 . 3	33 . 18
57 . 23	31 . 18	61 . 14	33 . 24
57 . 34	31 . 24	61 . 25	33 . 30
57 . 45	31 . 30		

END of the First Part.

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Table I. Of the Mean Motions of the Sun in Julian Years.

	Julian Years.	Mc. Mo. of ⊙				Mot. of Apo.				Præc. of Equi.			
		s	°	′	″	s	°	′	″	s	°	′	″
	1	11	29	45	40			1	3			0	51
	2	11	29	31	21			2	6			1	41
	3	11	29	17	1			3	9			2	32
B.	4	0	0	1	50			4	12			3	22
	5	11	29	47	30			5	15			4	13
	6	11	29	33	11			6	18			5	4
	7	11	29	18	51			7	21			5	54
B.	8	0	0	3	40			8	24			6	45
	9	11	29	49	20			9	27			7	35
	10	11	29	35	1			10	30			8	26
	11	11	29	20	41			11	33			9	17
B.	12	0	0	5	30			12	36			10	7
	13	11	29	51	10			13	39			10	58
	14	11	29	36	50			14	42			11	48
	15	11	29	22	31			15	45			12	39
B.	16	0	0	7	19			16	48			13	30
	17	11	29	53	0			17	51			14	20
	18	11	29	38	40			18	54			15	11
	19	11	29	24	21			19	57			16	1
B.	20	0	0	9	9			21	0			16	52
B.	40	0	0	18	19			42	0			33	44
B.	60	0	0	27	28		1	3	0			50	36
B.	80	0	0	36	37		1	24	0		1	7	28
B.	100	0	0	45	47		1	45	0		1	24	20
B.	200	0	1	31	33		3	30	0		2	48	40
B.	300	0	2	17	20		5	15	0		4	13	0
B.	400	0	3	3	7		7	0	0		5	37	20
B.	500	0	3	48	53		8	45	0		7	1	40
B.	600	0	4	34	40		10	30	0		8	26	0
B.	700	0	5	20	27		12	15	0		9	50	20
B.	800	0	6	6	13		14	0	0		11	14	40
B.	900	0	6	52	0		15	45	0		12	39	0
B.	1000	0	7	37	47		17	30	0		14	3	20
B.	2000	0	15	15	33	1	5	0	0		28	6	40
B.	3000	0	22	53	20	1	22	30	0	1	12	10	0
B.	4000	1	0	31	7	2	10	0	0	1	26	13	20
B.	5000	1	8	9	53	2	27	30	0	2	10	16	40
B.	6000	1	15	47	40	3	15	0	0	2	24	20	0

Table II. Epochs of the Sun's Mean Motions. Adapted to the Obſervatory of Paris.

Julian Style.		Mean Long. of ☉				Long. Apog.			
		s	°	′	″	s	°	′	″
Years bef. Chriſt.	600	9	3	25	1	1	27	29	27
	500	9	4	10	48	1	29	14	27
	400	9	4	56	34	2	0	59	27
	300	9	5	42	21	2	2	44	27
	200	9	6	28	8	2	4	29	27
	100	9	7	13	54	2	6	14	27
	0	9	7	59	41	2	7	59	27
	100	9	8	45	28	2	9	44	27
Years aft. C.	200	9	9	31	14	2	11	29	27
	300	9	10	17	1	2	13	14	27
	400	9	11	2	48	2	14	59	27
	500	9	11	48	34	2	16	44	27
	600	9	12	34	21	2	18	29	27
	700	9	13	20	8	2	20	14	27
	800	9	14	5	54	2	21	59	27
	900	9	14	51	41	2	23	44	27
	1000	9	15	37	28	2	25	29	27
	1100	9	16	23	15	2	27	14	27
	1200	9	17	9	1	2	28	59	27
	1300	9	17	54	48	3	0	44	27
	1400	9	18	40	35	3	2	29	27
	1460	9	19	8	3	3	3	32	27
	1480	9	19	17	12	3	3	53	27
	1500	9	19	26	22	3	4	14	27

Table II.

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Table II. Epochs of the Sun's Mean Motions. Adapted to the Obſervatory of Paris.

	Julian Style.	Mean Long. of ☉				Long. Apog.			
		s	°	′	″	s	°	′	″
Yrs af. C.	1520	9	19	35	31	3	4	35	27
	1540	9	19	44	40	3	4	56	27
	1560	9	19	53	50	3	5	17	27
	1580	9	20	2	59	3	5	38	27
	Gregorian Style.	Mean Long. of ☉				Long. Apog.			
		s	°	′	″	s	°	′	″
	1700	9	10	7	24	3	7	44	25
	1736	9	10	23	53	3	8	22	13
	1737	9	10	9	33	3	8	23	16
	1738	9	9	55	14	3	8	24	19
	1739	9	9	40	54	3	8	25	22
	1740	9	10	25	43	3	8	26	25
	1741	9	10	11	23	3	8	27	28
	1742	9	9	57	4	3	8	28	31
	1743	9	9	42	44	3	8	29	34
	1744	9	10	27	33	3	8	30	37
	1745	9	10	13	13	3	8	31	40
	1746	9	9	58	54	3	8	32	43
	1747	9	9	44	34	3	8	33	46
	1748	9	10	29	23	3	8	34	49
	1749	9	10	15	3	3	8	35	52
	1750	9	10	0	44	3	8	36	55
	1751	9	9	46	24	3	8	37	58

Table II. Epochs of the Sun's Mean Motions. Adapted to the Obſervatory of Paris.

Grego-rian Style.	Mean Long. of ⊙				Long. Apog.			
	s	°	′	″	s	°	′	″
1752	9	10	31	13	3	8	39	1
1753	9	10	16	53	3	8	40	4
1754	9	10	2	33	3	8	41	7
1755	9	9	48	14	3	8	42	10
1756	9	10	33	2	3	8	43	13
1757	9	10	18	43	3	8	44	16
1758	9	10	4	23	3	8	45	19
1759	9	9	50	4	3	8	46	22
1760	9	10	34	52	3	8	47	25
1761	9	10	20	32	3	8	48	28
1762	9	10	6	13	3	8	49	31
1763	9	9	51	53	3	8	50	34
1764	9	10	36	42	3	8	51	37
1765	9	10	22	22	3	8	52	40
1766	9	10	8	3	3	8	53	43
1767	9	9	53	43	3	8	54	46
1768	9	10	38	32	3	8	55	49
1769	9	10	24	12	3	8	56	52
1770	9	10	9	53	3	8	57	55
1771	9	9	55	33	3	8	58	58
1772	9	10	40	22	3	9	0	1
1773	9	10	26	2	3	9	1	4
1774	9	10	11	43	3	9	2	7
1775	9	9	57	23	3	9	3	10

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Table II. Epochs of the Sun's Mean Motion.

Adapted to the Observatory of Paris.

Gregorian Style.	Mean Long. of ⊙				Long. Apog.			
	s	°	′	″	s	°	′	″
1776	9	10	42	12	3	9	4	13
1777	9	10	27	52	3	9	5	16
1778	9	10	13	32	3	9	6	19
1779	9	9	59	13	3	9	7	22
1780	9	10	44	2	3	9	8	25
1781	9	10	29	42	3	9	9	28
1782	9	10	15	23	3	9	10	31
1783	9	10	1	3	3	9	11	34
1784	9	10	45	52	3	9	12	37
1785	9	10	31	32	3	9	13	40
1786	9	10	17	13	3	9	14	43
1787	9	10	2	53	3	9	15	46
1788	9	10	47	42	3	9	16	49
1789	9	10	33	22	3	9	17	52
1790	9	10	19	3	3	9	18	55
1791	9	10	4	43	3	9	19	58
1792	9	10	49	32	3	9	21	1
1793	9	10	35	12	3	9	22	4
1794	9	10	20	52	3	9	23	7
1795	9	10	6	33	3	9	24	10
1796	9	10	51	21	3	9	25	13
1797	9	10	37	2	3	9	26	16
1798	9	10	22	42	3	9	27	19
1799	9	10	8	23	3	9	28	22
1800	9	9	54	3	3	9	29	25

Table III. The Mean Motion of the Sun for Months and Days.

Days.	January.					February.					March.				
	Me. Lon. ☉				A.	Me. Lon. ☉				A.	Me. Lon. ☉				A.
	s	°	′	″	″	s	°	′	″	″	s	°	′	″	″
1	0	0	59	8	0	1	1	32	27	5	1	29	8	19	10
2	0	1	58	17	0	1	2	31	35	5	2	0	7	28	0
3	0	2	57	25	0	1	3	30	43	6	2	1	6	36	11
4	0	3	56	33	0	1	4	39	52	6	2	2	5	45	11
5	0	4	55	42	0	1	5	29	0	6	2	3	4	53	11
6	0	5	54	50	1	1	6	28	8	6	2	4	4	1	11
7	0	6	53	58	1	1	7	27	17	6	2	5	3	10	11
8	0	7	53	7	1	1	8	26	25	7	2	6	2	18	12
9	0	8	52	15	1	1	9	25	33	7	2	7	1	26	12
10	0	9	51	23	2	1	10	24	42	7	2	8	0	35	12
11	0	10	50	32	2	1	11	23	50	7	2	8	59	43	12
12	0	11	49	40	2	1	12	22	58	7	2	9	58	51	12
13	0	12	48	48	2	1	13	22	7	7	2	10	58	0	13
14	0	13	47	57	2	1	14	21	15	8	2	11	57	8	13
15	0	14	47	5	3	1	15	20	23	8	2	12	56	16	13
16	0	15	46	13	3	1	16	19	32	8	2	13	55	25	13
17	0	16	45	22	3	1	17	18	40	8	2	14	54	33	3
18	0	17	44	30	3	1	18	17	48	8	2	15	53	41	13
19	0	18	43	38	3	1	19	16	57	8	2	16	52	50	14
20	0	19	42	47	3	1	20	16	5	8	2	17	51	58	14
21	0	20	41	55	4	1	21	15	13	9	2	18	51	6	14
22	0	21	41	3	4	1	22	14	22	9	2	19	50	14	14
23	0	22	40	12	4	1	23	13	30	9	2	20	49	23	14
24	0	23	39	20	4	1	24	12	38	9	2	21	48	31	14
25	0	24	38	28	4	1	25	11	47	9	2	22	47	40	15
26	0	25	37	37	4	1	26	10	55	10	2	23	46	48	15
27	0	26	36	45	5	1	27	10	3	13	2	24	45	56	15
28	0	27	35	53	5	1	28	9	11	10	2	25	45	5	15
29	0	28	35	2	5	After Jan. Feb. ſubduct one Day.					2	26	44	13	15
30	0	29	34	10	5						2	27	43	21	16
31	1	0	33	18							2	28	42	30	16

In the Months of Jan. and Feb. of a Leap-Year, ſubduct one Day from the given Time.

Table III. The Mean Motion of the Sun for Months and Days.

Days.	April.					May.					June.				
	Me. Lon. ☉				A.	Me. Lon. ☉				A.	Me. Lon. ☉				A.
	s	°	′	″	″	s	°	′	″	″	s	°	′	″	″
1	2	29	41	38	16	3	29	15	48	21	4	29	49	6	26
2	3	0	40	47	16	4	0	14	56	21	5	0	48	15	26
3	3	1	39	55	16	4	1	14	5	21	5	1	47	23	27
4	3	2	39	3	17	4	2	13	13	22	5	2	46	31	27
5	3	3	38	11	17	4	3	12	21	22	5	3	45	39	27
6	3	4	37	20	17	4	4	11	30	22	5	4	44	48	27
7	3	5	36	28	17	4	5	10	38	22	5	5	43	56	27
8	3	6	35	36	17	4	6	9	46	22	5	6	43	4	27
9	3	7	34	45	18	4	7	8	55	22	5	7	42	13	28
10	3	8	33	53	18	4	8	8	3	23	5	8	41	21	28
11	3	9	33	1	18	4	9	7	11	23	5	9	40	29	28
12	3	10	32	10	18	4	10	6	20	23	5	10	39	38	28
13	3	11	31	18	18	4	11	5	28	23	5	11	38	46	28
14	3	12	30	26	18	4	12	4	36	23	5	12	37	55	29
15	3	13	29	34	19	4	13	3	45	23	5	13	37	3	29
16	3	14	28	43	19	4	14	2	53	24	5	14	36	11	29
17	3	15	27	51	19	4	15	2	1	24	5	15	35	20	29
18	3	16	27	0	19	4	16	1	10	24	5	16	34	28	29
19	3	17	26	8	19	4	17	0	18	24	5	17	33	36	29
20	3	18	25	16	19	4	17	59	26	24	5	18	32	45	30
21	3	19	24	25	20	4	18	58	35	25	5	19	31	53	30
22	3	20	23	33	20	4	19	57	43	25	5	20	31	1	30
23	3	21	22	41	20	4	20	56	51	25	5	21	30	10	30
24	3	22	21	50	20	4	21	56	0	25	5	22	29	18	30
25	3	23	20	58	20	4	22	55	8	25	5	23	28	26	31
26	3	24	20	6	20	4	23	54	16	25	5	24	27	35	31
27	3	25	19	15	21	4	24	53	25	26	5	25	26	43	31
28	3	26	18	23	21	4	25	52	33	26	5	26	25	51	31
29	3	27	17	31	21	4	26	51	41	26	5	27	25	0	31
30	3	28	16	40	21	4	27	50	50	26	5	28	24	8	31
31						4	28	49	58	26					

Table III. The Mean Motion of the Sun for Months and Days.

Days.	July.					August.					September.				
	Me. Lon. ⊙				A.	Me. Lon. ⊙				A.	Me. Lon. ⊙				A.
	s	°	′	″	″	s	°	′	″	″	s	°	′	″	″
1	5	29	23	16	31	6	29	56	34	37	8	0	29	52	42
2	6	0	22	24	31	7	0	55	42	37	8	1	29	1	43
3	6	1	21	33	32	7	1	54	51	37	8	2	28	9	43
4	6	2	20	41	32	7	2	53	59	38	3	3	27	17	43
5	6	3	19	49	32	7	3	53	7	38	8	4	26	26	43
6	6	4	18	58	32	7	4	52	16	38	8	5	25	34	43
7	6	5	18	6	32	7	5	51	24	38	8	6	24	42	43
8	6	6	17	14	33	7	6	50	32	38	8	7	23	51	44
9	6	7	16	22	33	7	7	49	41	38	8	8	22	59	44
10	6	8	15	31	33	7	8	48	49	39	3	9	22	7	44
11	6	9	14	39	33	7	9	47	57	39	8	10	21	16	44
12	6	10	13	47	33	7	10	47	6	39	1	11	20	24	44
13	6	11	12	56	34	7	11	46	14	39	8	12	19	32	44
14	6	12	12	4	34	7	12	45	22	39	8	13	18	41	45
15	6	13	11	12	34	7	13	44	31	40	8	14	17	49	45
16	6	14	10	21	34	7	14	43	39	40	8	15	16	57	45
17	6	15	9	29	34	7	15	42	47	40	8	16	16	5	45
18	6	16	8	37	34	7	16	41	56	40	8	17	15	14	45
19	6	17	7	46	35	7	17	41	4	40	8	18	14	22	45
20	6	18	6	54	35	7	18	40	12	40	8	19	13	30	46
21	6	19	6	2	35	7	19	39	21	41	8	20	12	39	46
22	6	20	5	11	35	7	20	38	29	41	8	21	11	47	46
23	6	21	4	19	35	7	21	37	37	41	8	22	10	55	46
24	6	22	3	28	36	7	22	36	46	41	8	23	10	4	46
25	6	23	2	36	36	7	23	35	54	41	8	24	9	12	46
26	6	24	1	44	36	7	24	35	2	42	8	25	8	20	47
27	6	25	0	52	36	7	25	34	11	42	8	26	7	29	47
28	6	26	0	1	36	7	26	33	19	42	8	27	6	37	47
29	6	26	59	9	36	7	27	32	27	42	8	28	5	45	47
30	6	27	58	17	37	7	28	31	36	42	8	29	4	54	47
31	6	28	57	26	37	7	29	30	44	42					

Table III. The Mean Motion of the Sun for Months and Days.

Days.	October.					November.					December.					
	Me. Lon. ⊙				A.	Me. Long. ⊙				A.	Me. Long. ⊙				Ap.	
	s	°	′	″	″	s	°	′	″	″	s	°	′	″	′	″
1	9	0	4	2	47	10	0	37	20	53	11	0	11	30		58
2	9	1	3	10	48	10	1	36	29	53	11	1	10	38		58
3	9	2	2	19	48	10	2	35	37	53	11	2	9	47		58
4	9	3	1	27	48	10	3	34	45	53	11	3	8	55		58
5	9	4	0	35	48	10	4	33	54	53	11	4	8	3		59
6	9	4	59	44	48	10	5	33	2	54	11	5	7	12		59
7	9	5	58	52	48	10	6	32	10	54	11	6	6	20		59
8	9	6	58	0	49	10	7	31	19	54	11	7	5	28		59
9	9	7	57	8	49	10	8	30	27	54	11	8	4	37		59
10	9	8	56	17	49	10	9	29	35	54	11	9	3	45		59
11	9	9	55	25	49	10	10	28	44	54	11	10	2	53	1	0
12	9	10	54	34	49	10	11	27	52	54	11	11	2	2	1	0
13	9	11	53	42	49	10	12	27	0	55	11	12	1	10	1	0
14	9	12	52	50	50	10	13	26	9	55	11	13	0	18	1	0
15	9	13	51	59	50	10	14	25	17	55	11	13	59	27	1	0
16	9	14	51	7	50	10	15	24	25	55	11	14	58	35	1	0
17	9	15	50	15	50	10	16	23	34	55	11	15	57	43	1	1
18	9	16	49	24	50	10	17	22	42	55	11	16	56	52	1	1
19	9	17	48	32	50	10	18	21	50	56	11	17	56	0	1	1
20	9	18	47	40	51	10	19	20	59	56	11	18	55	8	1	1
21	9	19	46	49	51	10	20	20	7	56	11	19	54	17	1	1
22	9	20	45	57	51	10	21	19	15	56	11	20	53	25	1	1
23	9	21	45	5	51	10	22	18	24	56	11	21	52	33	1	2
24	9	22	44	14	51	10	23	17	32	56	11	22	51	42	1	2
25	9	23	43	22	51	10	24	16	40	57	11	23	50	50	1	2
26	9	24	42	30	52	10	25	15	49	57	11	24	49	58	1	2
27	9	25	41	39	52	10	26	14	57	57	11	25	49	7	1	2
28	9	26	40	47	52	10	27	14	5	57	11	26	48	15	1	2
29	9	27	39	55	52	10	28	13	13	57	11	27	47	23	1	3
30	9	28	39	4	52	10	29	12	22	57	11	28	46	32	1	3
31	9	29	38	12	53						11	29	45	40		

Table IV. The Mean Motion of the Sun for Hours and Minutes.

	Me. Lo. ⊙				Me. Lo. ⊙		
h.	°	′	″	h.	°	′	″
′	′	″	‴	′	′	″	‴
″	″	‴	⁗	″	″	‴	⁗
0	0	0	0	30	1	13	55
1	0	2	28	31	1	16	23
2	0	4	56	32	1	18	51
3	0	7	24	33	1	21	19
4	0	9	51	34	1	23	47
5	0	12	19	35	1	26	14
6	0	14	47	36	1	28	42
7	0	17	15	37	1	31	10
8	0	19	43	38	1	33	38
9	0	22	11	39	1	36	6
10	0	24	38	40	1	38	34
11	0	27	6	41	1	41	2
12	0	29	34	42	1	43	29
13	0	32	2	43	1	45	57
14	0	34	30	44	1	48	25
15	0	36	58	45	1	50	53
16	0	39	25	46	1	53	21
17	0	41	53	47	1	55	49
18	0	44	21	48	1	58	17
19	0	46	49	49	2	0	44
20	0	49	17	50	2	3	12
21	0	51	45	51	2	5	40
22	0	54	13	52	2	8	8
23	0	56	40	53	2	10	36
24	0	59	8	54	2	13	3
25	1	1	36	55	2	15	31
26	1	4	4	56	2	17	59
27	1	6	32	57	2	20	27
28	1	9	0	58	2	22	55
29	1	11	27	59	2	25	23
30	1	13	55	60	2	27	50

Table V. Of the apparent Diameter and Hourly Motion of the Sun.

⊙ M. Anom		Diamet. of ⊙		Hor. Mot.		⊙ Mean Anom	
S	°	′	″	′	″	S	°
0	0	31	34	2	23	12	0
	6	31	34	2	23		24
	12	31	34	2	23		18
	18	31	35	2	23		12
	24	31	36	2	23		6
1	0	31	38	2	24	11	0
	6	31	40	2	24		24
	12	31	42	2	24		18
	18	31	44	2	25		12
	24	31	47	2	25		6
2	0	31	49	2	25	10	0
	6	31	52	2	26		24
	12	31	56	2	26		18
	18	31	59	2	27		12
	24	32	2	2	27		6
3	0	32	5	2	28	9	0
	6	32	9	2	28		24
	12	32	12	2	29		18
	18	32	15	2	29		12
	24	32	19	2	30		6
4	0	32	22	2	30	8	0
	6	32	25	2	31		24
	12	32	27	2	31		18
	18	32	30	2	31		12
	24	32	32	2	32		6
5	0	32	34	2	32	7	0
	6	32	35	2	32		24
	12	32	37	2	33		18
	18	32	38	2	33		12
	24	32	38	2	33		6
6	0	32	38	2	33	6	0

Table VI.

Table VI. The Equation of the Sun's Center: The Argum. The Sun's Mean Anomaly.

	0		1		2		
	Sub.	Diff.	Sub.	Diff.	Sub.	Diff.	
	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	
0	0 0 0	1 59	0 56 43	1 42	1 38 58	1 1	30
1	0 1 59	1 59	0 58 25	1 41	1 39 59	0 59	29
2	0 3 58	1 58	1 0 6	1 41	1 40 58	0 57	28
3	0 5 56	1 58	1 1 47	1 40	1 41 55	0 55	27
4	0 7 54	1 58	1 3 27	1 39	1 42 50	0 54	26
5	0 9 52		1 5 6		1 43 44		25
		1 58		1 38		0 52	
6	0 11 50	1 58	1 6 44	1 37	1 44 36	0 50	24
7	0 13 48	1 57	1 8 21	1 36	1 45 26	0 48	23
8	0 15 45	1 57	1 9 57	1 34	1 46 14	0 46	22
9	0 17 42	1 57	1 11 31	1 33	1 47 0	0 44	21
10	0 19 39		1 13 4		1 47 44		20
		1 57		1 32		0 42	
11	0 21 36	1 56	1 14 36	1 30	1 48 26	0 40	19
12	0 23 32	1 56	1 16 6	1 29	1 49 6	0 38	18
13	0 25 28	1 55	1 17 35	1 27	1 49 44	0 36	17
14	0 27 23	1 55	1 19 2	1 26	1 50 20	0 35	16
15	0 29 18		1 20 28		1 50 55		15
		1 54		1 25		0 33	
16	0 31 12	1 54	1 21 53	1 23	1 51 28	0 31	14
17	0 33 6	1 53	1 23 16	1 22	1 51 59	0 29	13
18	0 34 59	1 53	1 24 38	1 20	1 52 28	0 27	12
19	0 36 52	1 52	1 25 58	1 19	1 52 55	0 24	11
20	0 38 44		1 27 17		1 53 19		10
		1 51		1 17		0 22	
21	0 40 35	1 51	1 28 34	1 16	1 53 41	0 20	9
22	0 42 26	1 50	1 29 50	1 14	1 54 1	0 18	8
23	0 44 16	1 49	1 31 4	1 13	1 54 19	0 16	7
24	0 46 5	1 49	1 32 17	1 11	1 54 35	0 15	6
25	0 47 54		1 33 28		1 54 50		5
		1 48		1 9		0 12	
26	0 49 42	1 47	1 34 37	1 8	1 55 2	0 10	4
27	0 51 29	1 46	1 35 45	1 6	1 55 12	0 8	3
28	0 53 15	1 45	1 36 51	1 4	1 55 20	0 6	2
29	0 55 0	1 43	1 37 55	1 2	1 55 26	0 3	1
30	0 56 43		1 38 58		1 55 29		0
	Add		Add		Add		
	11		10		9		

Table VI. The Equation of the Sun's Center.

The Argum. The Sun's Mean Anomaly.

	3		4		5		
	Sub.	Diff.	Sub.	Diff.	Sub.	Diff.	
	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	
0	1 55 29	0 1	1 41 4	1 0	0 58 49	1 47	30
1	1 55 30	0 1	1 40 4	1 2	0 57 2	1 48	29
2	1 55 29	0 3	1 39 2	1 4	0 55 14	1 49	28
3	1 55 26	0 5	1 37 58	1 6	0 53 25	1 50	27
4	1 55 21	0 6	1 36 52	1 7	0 51 35	1 50	26
5	1 55 15	0 9	1 35 45	1 10	0 49 45	1 51	25
6	1 55 6	0 11	1 34 35	1 11	0 47 54	1 52	24
7	1 54 55	0 13	1 33 24	1 13	0 46 2	1 53	23
8	1 54 42	0 16	1 32 11	1 15	0 44 9	1 55	22
9	1 54 26	0 18	1 30 56	1 16	0 42 14	1 56	21
10	1 54 8	0 20	1 29 40	1 18	0 40 18	1 56	20
11	1 53 48	0 22	1 28 22	1 20	0 38 22	1 57	19
12	1 53 26	0 24	1 27 2	1 21	0 36 25	1 57	18
13	1 53 2	0 26	1 25 41	1 23	0 34 28	1 58	17
14	1 52 36	0 27	1 24 18	1 25	0 32 30	1 59	16
15	1 52 9	0 30	1 22 53	1 26	0 30 31	1 59	15
16	1 51 39	0 32	1 21 27	1 28	0 28 32	2 0	14
17	1 51 7	0 34	1 19 59	1 29	0 26 32	2 0	13
18	1 50 33	0 36	1 18 30	1 31	0 24 32	2 1	12
19	1 49 57	0 39	1 16 59	1 32	0 22 31	2 2	11
20	1 49 18	0 41	1 15 27	1 34	0 20 29	2 2	10
21	1 48 37	0 43	1 13 53	1 35	0 18 27	2 2	9
22	1 47 54	0 44	1 12 18	1 37	0 16 25	2 2	8
23	1 47 10	0 46	1 10 41	1 38	0 14 23	2 3	7
24	1 46 24	0 48	1 9 3	1 39	0 12 20	2 3	6
25	1 45 36	0 50	1 7 24	1 40	0 10 17	2 3	5
26	1 44 46	0 52	1 5 44	1 42	0 8 14	2 3	4
27	1 43 54	0 54	1 4 2	1 43	0 6 11	2 3	3
28	1 43 0	0 57	1 2 19	1 44	0 4 8	2 4	2
29	1 42 3	0 59	1 0 35	1 46	0 2 4	2 4	1
30	1 41 4		0 58 49		0 0 0		0
	Add		Add		Add		
	8		7		6		

Table VII.

Table VII. The Diſtance of the Sun from the Earth, in Parts of which the mean Diſtance contains 100000.

Argum. The Sun's Mean Anomaly.

	0	1	2	3	4	5	
0	101680	101462	100861	100028	99182	98553	30
1	101680	101448	100836	99999	99156	98538	29
2	101679	101433	100811	99969	99131	98524	28
3	101678	101418	100785	99940	99106	98510	27
4	101676	101402	100759	99911	99081	98496	26
5	101674	101385	100733	99882	99056	98483	25
6	101671	101368	100707	99853	99031	98470	24
7	101668	101351	100680	99824	99007	98458	23
8	101664	101334	100653	98794	98983	98446	22
9	101660	101316	100626	98765	98960	98435	21
10	101655	101298	100599	98736	98937	98425	20
11	101650	101280	100572	99707	98914	98415	19
12	101644	101261	100545	99678	98892	98405	18
13	101638	101242	100517	99649	98870	98396	17
14	101631	101222	100489	99620	98848	98387	16
15	101624	101202	100461	99592	98827	98379	15
16	101617	101182	100433	99563	98806	98371	14
17	101609	101161	100405	99535	98785	98364	13
18	101601	101140	100377	99507	98765	98358	12
19	101592	101118	100348	99479	98745	98352	11
20	101582	101096	100319	99451	98725	98347	10
21	101572	101074	100290	99423	98706	98342	9
22	101561	101051	100261	99395	98687	98338	8
23	101550	101028	100232	99368	98669	98334	7
24	101539	101005	100203	99341	98651	98330	6
25	101527	100982	100174	99314	98634	98327	5
26	101515	100959	100145	99287	98617	98324	4
27	101502	100935	100116	99261	98600	98322	3
28	101486	100911	100087	99234	98584	98321	2
29	101476	100886	100057	99208	98568	98320	1
30	101462	100861	100028	99182	98553	98320	0
	11	10	9	8	7	6	

Table VIII. A Correction of the Sun's Longitude, and Diſtance from the Earth.

Argum. The Diſtance of the Moon from the Sun.

	0		1		2		3		4		5		
	Add	Ad.	Add	Ad.	Add	Ad.	Add	Su.	Add	S .	Add	Su.	
	Long.	Diſ.	Lon.	Diſ.	Lon.	Diſ.	Lon.	Diſ.	Lon.	Diſ.	Lon.	Diſ.	
	′ ″	Par.	′ ″	Par.	′ ″	Par.	′ ″	Par.	′ ″	Par.	′ ″	Par.	
0	0 0	5	0 5	4	0 9	3	0 10	0	0 9	3	0 5	4	30
1	0 0	5	0 5	4	0 9	2	0 10	0	0 9	3	0 5	4	29
2	0 0	5	0 5	4	0 9	2	0 10	0	0 8	3	0 5	4	28
3	0 1	5	0 5	4	0 9	2	0 10	0	0 8	3	0 5	4	27
4	0 1	5	0 6	4	0 9	2	0 10	0	0 8	3	0 4	4	26
5	0 1	5	0 6	4	0 9	2	0 10	0	0 8	3	0 4	5	25
6	0 1	5	0 6	4	0 9	2	0 10	1	0 8	3	0 4	5	24
7	0 1	5	0 6	4	0 9	2	0 10	1	0 8	3	0 4	5	23
8	0 1	5	0 6	4	0 9	2	0 10	1	0 8	3	0 4	5	22
9	0 2	5	0 6	4	0 9	2	0 10	1	0 8	3	0 4	5	21
10	0 2	5	0 6	4	0 9	2	0 10	1	0 8	3	0 3	5	20
11	0 2	5	0 7	4	0 9	2	0 10	1	0 8	3	0 3	5	19
12	0 2	5	0 7	4	0 10	2	0 10	1	0 7	3	0 3	5	18
13	0 2	5	0 7	4	0 10	1	0 10	1	0 7	3	0 3	5	17
14	0 2	5	0 7	4	0 10	1	0 10	1	0 7	3	0 3	5	16
15	0 3	5	0 7	4	0 10	1	0 10	1	0 7	4	0 3	5	15
16	0 3	5	0 7	3	0 10	1	0 10	1	0 7	4	0 2	5	14
17	0 3	5	0 7	3	0 10	1	0 10	1	0 7	4	0 2	5	13
18	0 3	5	0 7	3	0 10	1	0 10	2	0 7	4	0 2	5	12
19	0 3	5	0 8	3	0 10	1	0 9	2	0 7	4	0 2	5	11
20	0 3	5	0 8	3	0 10	1	0 9	2	0 6	4	0 2	5	10
21	0 4	5	0 8	3	0 10	1	0 9	2	0 6	4	0 2	5	9
22	0 4	5	0 8	3	0 10	1	0 9	2	0 6	4	0 1	5	8
23	0 4	5	0 8	3	0 10	1	0 9	2	0 6	4	0 1	5	7
24	0 4	5	0 8	3	0 10	1	0 9	2	0 6	4	0 1	5	6
25	0 4	5	0 8	3	0 10	0	0 9	2	0 6	4	0 1	5	5
26	0 4	4	0 8	3	0 10	0	0 9	2	0 6	4	0 1	5	4
27	0 5	4	0 8	3	0 10	0	0 9	2	0 5	4	0 1	5	3
28	0 5	4	0 8	3	0 10	0	0 9	2	0 5	4	0 0	5	2
29	0 5	4	0 9	3	0 10	0	0 9	2	0 5	4	0 0	5	1
30	0 5	4	0 9	3	0 10	0	0 9	3	0 5	4	0 0	5	0
	Sub.	Ad.	Sub.	Ad.	Sub.	Ad.	Sub.	Su.	Add	Su.	Add	Su.	
	11		10		9		8		7		6		

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Table IX. The Equation of the Equinoctial Points, and of the Obliquity of the ECLIPTIC.

Argu. Long. ☊.		Equat. of the Equi. Points.	The Obliquity of the Ecliptic.			Equat. of the Equi. Points.	Argu. Long. ☊.	
s	°	Subt. ″	°	′	″	Add ″	s	°
0	0	0	23	28	39,7	0	12	0
	6	1,9			39,6	1,9		24
	12	3,7			39,4	3,7		18
	18	5,5			39,2	5,5		12
	24	7,3			38,9	7,3		6
1	0	9,1	23	28	38,4	9,1	11	0
	6	10,6			37,8	10,6		24
	12	12,1			37,2	12,1		18
	18	13,5			36,5	13,5		12
	24	14,7			35,7	14,7		6
2	0	15,7	23	28	34,9	15,7	10	0
	6	16,5			33,9	16,5		24
	12	17,2			33,0	17,2		18
	18	17,7			32,0	17,7		12
	24	18,0			31,0	18,0		6
3	0	18,1	23	28	30,0	18,1	9	0
	6	18,0			29,0	18,0		24
	12	17,7			28,0	17,7		18
	18	17,2			27,0	17,2		12
	24	16,5			26,1	16,5		6
4	0	15,7	23	28	25,1	15,7	8	0
	6	14,7			24,3	14,7		24
	12	13,5			23,5	13,5		18
	18	12,1			22,8	12,1		12
	24	10,6			22,2	10,6		6
5	0	9,1	23	28	21,6	9,1	7	0
	6	7,3			21,1	7,3		24
	12	5,5			20,8	5,5		18
	18	3,7			20,6	3,7		12
	24	1,9			20,4	1,9		6
6	0	0	23	28	20,3	0	6	0
s	°	Subt. ″	°	′	″	Add ″	s	°
		Equat. of Equinoct. Points.	The Obliquity of the Ecliptic.			Equat. of Equinoct. Points.		

TABLES

OF THE

MOON's MOTIONS,

Calculated according to

The THEORY of UNIVERSAL GRAVITATION.

By Mr. CLAIRAUT.

Table I. Epochs for the Arguments of the Equations of the Moon's Place.

	Gre. Style	Suppl. of ☊				☾				A			
		s	°	′	″	s	°	′	″	s	°	′	″
B	1736	5	18	45	16	4	6	22	18	5	26	2	1
	37	6	8	4	59	8	15	45	23	8	24	45	15
	38	6	27	24	42	0	25	8	28	11	23	28	29
	39	7	16	44	25	5	4	31	32	2	22	11	43
B	1740	8	6	7	19	9	27	5	12	6	3	58	52
	41	8	25	27	2	2	6	28	17	9	2	42	6
	42	9	14	46	45	6	15	51	21	0	1	25	20
	43	10	4	6	28	10	25	14	26	3	0	8	34
B	1744	10	23	29	22	3	17	48	6	6	11	55	43
	45	11	12	49	5	7	27	11	10	9	10	38	57
	46	0	2	8	48	0	6	34	15	0	9	22	11
	47	0	21	28	31	4	15	57	20	3	8	5	25
B	1748	1	10	51	25	9	8	30	59	6	19	52	33
	49	2	0	11	8	1	17	54	4	9	18	35	47
	50	2	19	30	51	5	27	17	8	0	17	19	1
	51	3	8	50	34	10	6	40	13	3	16	2	15
B	1752	3	28	13	28	2	29	13	53	6	27	49	24
	53	4	17	33	11	7	8	36	57	9	26	32	38
	54	5	6	52	54	11	18	0	2	0	25	15	52
	55	5	26	12	37	3	27	23	7	3	23	59	6
B	1756	6	15	35	31	8	19	56	46	7	5	46	15
	57	7	4	55	14	0	29	19	51	10	4	29	29
	58	7	24	14	57	5	8	42	56	1	3	12	43
	59	8	13	34	40	9	18	6	0	4	1	55	57
B	1760	9	2	57	34	2	10	39	40	7	13	43	5
	61	9	22	17	17	6	20	2	45	10	12	26	19
	62	10	11	37	0	10	29	25	49	1	11	9	33
	63	11	0	56	43	3	8	48	54	4	9	52	47
B	1764	11	20	19	37	8	1	22	34	7	21	39	57
	65	0	9	39	20	0	10	45	38	10	20	23	11
	66	0	28	59	3	4	20	8	43	1	19	6	25
	67	1	18	18	46	8	29	31	48	4	17	49	39
B	1768	2	7	41	40	1	22	5	27	7	29	36	47
	69	2	27	1	23	6	1	28	32	10	28	20	1
	70	3	16	21	6	10	10	51	36	1	27	3	15
	71	4	5	40	49	2	20	14	41	4	25	46	29
B	1772	4	25	3	43	7	12	48	21	8	7	33	38
	73	5	14	23	26	11	22	11	26	11	6	16	52
	74	6	3	43	9	4	1	34	31	2	5	0	6
	75	6	23	2	52	8	10	57	36	5	3	43	20
B	1776	7	12	25	46	1	3	31	16	8	15	30	29

Con-

Continuation of Table I.

Yrs	B				C				D			E		
	s	°	'	"	s	°	'	"	s	°	'	S	°	'
1736	8	17	54	51	7	6	58	26	6	2	1	5	28	39
37	2	8	26	25	11	16	35	50	6	1	45	7	6	50
38	7	28	58	0	3	26	13	14	6	1	29	8	15	0
39	1	19	29	34	8	5	50	39	6	1	15	9	23	11
1740	7	21	20	7	0	27	39	30	6	1	59	11	3	27
41	1	11	51	42	5	7	16	54	6	1	43	0	11	37
42	7	2	23	16	9	16	54	18	6	1	27	1	19	48
43	0	22	54	50	1	26	31	42	6	1	12	2	27	59
1744	6	24	45	24	6	18	20	33	6	1	56	4	8	14
45	0	15	16	58	10	27	57	57	6	1	40	5	16	25
46	6	5	48	32	3	7	35	21	6	1	25	6	24	36
47	11	26	20	7	7	17	12	46	6	1	9	8	2	47
1748	5	28	10	40	0	9	1	37	6	1	53	9	13	2
49	11	18	42	15	4	18	39	1	6	1	38	10	21	13
50	5	9	13	49	8	28	16	25	6	1	23	11	29	24
51	10	29	45	23	1	7	53	49	6	1	7	1	7	34
1752	5	1	35	57	5	29	42	40	6	1	51	2	17	50
53	10	22	7	31	10	9	20	4	6	1	36	3	26	0
54	4	12	39	5	2	18	57	28	6	1	20	5	4	11
55	10	3	10	39	6	28	34	53	6	1	4	6	12	22
1756	4	5	1	13	11	20	23	44	6	1	48	7	22	37
57	9	25	32	47	4	0	1	8	6	1	33	9	0	48
58	3	16	4	22	8	9	38	32	6	1	18	10	8	59
59	9	6	35	56	0	19	15	56	6	1	2	11	17	11
1760	3	8	26	29	5	11	4	48	6	1	46	0	27	26
61	8	28	58	4	9	20	42	12	6	1	31	2	5	37
62	2	19	29	38	2	0	19	36	5	1	16	3	13	48
63	8	10	1	12	6	9	57	1	6	0	59	4	21	59
1764	2	11	51	46	11	1	45	51	6	1	43	6	2	14
65	8	2	23	20	3	11	23	16	6	1	28	7	10	25
66	1	22	54	54	7	21	0	40	6	1	13	8	18	35
67	7	13	26	29	0	0	38	4	6	0	57	9	26	46
1768	1	15	17	2	4	22	26	55	6	1	41	11	7	2
69	7	5	48	36	9	2	4	19	6	1	25	0	15	13
70	0	26	20	11	1	11	41	43	6	1	9	1	23	23
71	6	16	51	45	5	21	19	8	6	0	54	3	1	35
1772	0	18	42	19	10	13	7	58	6	1	38	4	11	50
73	6	9	13	53	2	22	45	23	6	1	23	5	20	1
74	11	29	45	27	7	2	22	47	6	1	8	6	28	12
75	5	20	17	2	11	12	0	11	6	0	52	8	6	23
1776	11	22	7	35	4	3	49	2	6	1	36	9	16	38

Second Part of Table I:

	Yrs	a	b	c	d	e	f	g
B	1736	886 29	210 85	699 83	694 36	983 43	994 53	921 78
	1737	772 67	685 24	420 67	660 94	230 59	240 26	115 59
	1738	659 05	159 64	141 51	627 51	477 74	486 00	309 40
	1739	545 43	634 03	862 35	594 08	724 90	731 73	503 21
B	1740	434 24	137 12	648 18	664 67	005 61	016 50	796 19
	1741	320 62	611 51	369 01	631 25	252 76	262 23	990 00
	1742	207 01	085 91	089 85	597 82	499 92	507 97	183 81
	1743	093 39	560 30	810 69	564 40	747 07	753 70	377 62
B	1744	982 20	063 39	596 52	634 99	027 78	038 47	670 60
	1745	868 58	537 79	317 36	601 56	274 94	284 20	864 41
	1746	754 96	012 18	038 20	568 14	522 09	529 94	058 22
	1747	641 34	486 57	759 04	534 71	769 25	775 67	252 03
B	1748	530 15	989 66	544 86	605 30	049 96	060 44	545 00
	1749	416 53	464 06	265 70	571 87	297 11	306 17	738 82
	1750	302 91	938 45	986 54	538 45	544 27	551 91	932 63
	1751	189 29	412 84	707 38	505 02	791 42	797 64	126 44
B	1752	078 10	915 93	493 21	575 61	072 13	082 41	419 41
	1753	964 48	390 33	214 05	542 19	319 29	328 14	613 23
	1754	850 86	864 72	934 89	508 76	566 44	573 88	807 04
	1755	737 24	339 12	655 72	475 34	813 60	819 61	000 85
B	1756	626 05	842 20	441 55	545 93	094 31	104 37	293 82
	1757	512 43	316 60	162 39	512 50	341 46	350 11	487 63
	1758	398 81	790 99	883 23	479 07	588 62	595 84	681 45
	1759	285 19	265 39	604 07	445 65	835 77	841 58	875 26
B	1760	174 00	768 48	389 90	516 24	116 48	126 34	168 23
	1761	060 38	242 87	110 73	482 81	363 64	372 08	362 04
	1762	946 77	717 26	831 57	449 39	610 79	617 81	555 86
	1763	833 15	191 66	552 41	415 96	857 95	863 55	749 67
B	1764	721 96	694 75	338 24	486 55	138 66	148 31	042 64
	1765	608 34	169 14	059 08	453 13	385 81	394 05	236 45
	1766	494 72	643 53	779 92	419 70	632 97	639 78	430 26
	1767	381 10	117 93	500 76	386 27	880 12	885 52	624 08
B	1768	269 91	621 02	286 58	456 87	160 83	170 28	917 05
	1769	146 29	095 41	007 42	423 44	407 99	416 02	110 86
	1770	032 67	569 81	728 26	390 01	655 14	661 75	304 67
	1771	919 05	044 20	449 10	356 59	902 30	907 49	498 49
B	1772	817 86	547 29	234 93	427 18	183 01	192 25	791 46
	1773	704 24	021 68	955 77	393 75	430 16	437 99	985 27
	1774	590 62	496 08	676 61	360 33	677 32	683 72	179 08
	1775	477 00	970 47	397 44	326 90	924 47	929 46	372 89
B	1776	365 81	473 56	183 27	307 49	205 18	214 22	665 87

Second

Second Part of Table I.

Yrs	h	i	k	l	m	n	o	p
1736	213 10	091 7	221 9	710 9	188 8	278 1	472 4	261 6
1737	792 84	698 2	694 9	430 3	156 1	050 2	966 0	280 8
1738	372 58	304 7	167 9	149 8	123 4	822 2	459 6	300 0
1739	952 31	911 2	640 9	869 2	090 7	594 3	953 2	319 2
1740	569 26	587 9	148 0	659 1	159 2	373 9	516 7	379 5
1741	148 99	194 4	621 0	378 5	126 5	146 0	010 3	398 8
1742	728 73	800 9	094 0	097 9	093 8	918 0	503 9	418 0
1743	308 47	407 4	566 9	817 3	061 1	690 1	997 5	437 2
1744	925 41	084 0	074 1	607 2	129 7	469 7	560 9	497 5
1745	505 15	690 6	547 1	326 6	096 9	241 8	054 5	516 7
1746	084 89	297 1	020 0	046 0	064 2	013 8	548 1	535 9
1747	664 62	903 6	493 0	765 5	031 5	785 9	041 7	555 2
1748	281 57	580 2	000 2	555 3	100 3	565 5	605 2	615 5
1749	861 30	186 7	473 1	274 8	067 4	337 6	098 8	634 7
1750	441 04	793 3	946 1	994 2	034 6	109 6	592 4	653 9
1751	020 78	399 8	419 1	713 6	001 9	881 7	086 0	673 1
1752	637 72	076 4	926 2	503 5	070 5	661 3	649 4	733 5
1753	217 46	682 9	399 2	222 9	037 8	433 4	143 0	752 7
1754	797 20	289 4	872 2	942 3	005 0	205 4	636 6	771 9
1755	376 93	896 0	345 1	661 7	972 3	977 5	130 2	791 1
1756	993 88	572 6	852 3	451 6	040 9	757 1	693 7	851 5
1757	573 61	179 1	325 3	171 0	008 2	529 2	187 3	870 7
1758	153 35	785 6	798 2	890 5	975 5	301 2	680 9	889 9
1759	733 09	392 1	271 2	609 9	942 8	073 3	174 5	909 1
1760	350 03	068 8	778 4	399 8	011 3	852 9	737 9	969 4
1761	929 77	675 3	251 3	119 2	978 6	625 0	231 5	988 7
1762	509 51	281 8	724 3	838 6	945 9	397 0	725 1	007 9
1763	089 24	888 3	197 3	558 0	913 2	169 1	218 7	027 1
1764	706 19	565 0	704 4	347 9	981 8	948 7	782 2	087 4
1765	285 92	171 5	177 4	067 3	949 0	720 8	275 8	106 6
1766	865 66	778 0	650 4	786 7	916 3	492 8	769 4	125 8
1767	445 40	384 5	123 3	506 2	883 6	264 9	263 0	145 1
1768	062 34	061 2	630 5	296 0	952 2	044 5	826 4	205 4
1769	642 08	667 7	103 5	015 5	919 5	816 6	320 0	224 6
1770	221 82	274 2	576 4	734 9	886 7	588 6	813 6	243 8
1771	801 55	880 7	049 4	454 3	854 0	360 7	307 2	263 0
1772	418 50	557 4	556 6	244 2	922 6	140 3	870 7	323 4
1773	998 23	163 9	029 5	963 6	889 9	912 4	364 3	342 6
1774	577 97	770 4	502 5	683 0	857 2	684 4	857 9	361 8
1775	157 71	376 9	975 5	402 4	824 4	456 5	351 5	381 0
1776	774 65	053 6	482 6	192 3	893 0	236 1	914 9	441 4

Table II. Of the Mean Motions for Months.

	Suppl. of ☊				☾				A				B				C				D			E		
	s	°	′	″	s	°	′	″	s	°	′	″	s	′	″	″	s	°	′	″	s	°	′	s	°	′
Jan.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb.	0	1	38	30	1	18	28	6	1	15	0	53	11	20	48	42	0	17	54	47	1	0	33	2	4	24
Mar.	0	3	7	28	1	27	24	26	1	20	50	3	10	7	40	27	11	29	15	15	1	28	9	4	2	33
Apr.	0	4	45	57	3	15	52	32	3	5	50	55	9	28	29	9	0	17	10	2	2	28	42	6	6	57
May	0	6	21	17	4	21	10	2	4	7	47	54	9	7	58	52	0	22	53	23	3	28	16	8	9	16
June	0	7	59	47	6	9	38	8	5	22	48	47	8	28	47	35	1	10	48	11	4	28	50	10	13	39
July	0	9	35	6	7	14	55	39	6	24	45	45	8	8	17	18	1	16	31	32	5	28	24	0	15	58
Aug.	0	11	13	35	9	3	23	45	8	9	46	38	7	29	6	0	2	4	26	19	6	28	57	2	20	22
Sept.	0	12	52	5	10	21	51	50	9	24	47	31	7	19	54	42	2	22	21	7	7	29	30	4	24	46
Oct.	0	14	27	24	11	27	9	21	10	26	44	29	6	29	24	25	2	28	4	27	8	29	4	6	27	5
Nov.	0	16	5	53	1	15	37	26	0	11	45	22	6	20	13	8	3	15	59	15	9	29	37	9	1	28
Dec.	0	17	41	12	2	20	54	57	1	13	42	20	5	29	42	51	3	21	42	36	10	29	11	11	3	47

Second Part of Table II.

	a	b	c	d	e	f	g	h	i	k	l	m	n	o	p
Jan.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb.	075 28	889 61	014 65	224 56	040 17	209 91	074 00	153 35	174 8	059 4	184 4	139 7	235 4	165 2	275 6
Mar.	143 28	693 12	834 33	137 06	979 68	302 74	850 51	195 08	139 1	016 2	157 4	975 5	448 1	120 9	427 8
Apr.	218 56	582 73	848 97	361 62	019 85	512 65	924 50	348 43	313 9	075 5	341 8	115 2	683 5	286 1	703 4
May	291 41	443 64	798 63	482 16	026 46	683 53	899 34	464 57	418 6	100 7	455 7	153 6	911 4	381 4	937 8
June	366 69	333 24	813 28	706 72	066 63	893 44	973 33	617 92	593 4	160 1	640 1	293 3	146 8	546 7	213 4
July	439 55	194 15	762 94	827 26	073 25	064 32	948 16	734 06	698 0	185 2	754 0	331 7	374 6	642 0	447 9
Aug.	514 83	083 76	777 58	051 82	113 42	274 23	022 16	887 41	872 8	244 6	938 4	471 4	610 1	807 2	723 5
Sept.	590 11	973 36	792 23	276 38	153 59	484 15	096 15	040 76	047 6	303 9	122 8	611 1	845 5	972 4	999 1
Oct.	662 96	834 27	741 89	396 92	160 20	655 03	070 99	156 90	152 3	329 1	236 7	649 5	073 3	067 8	233 5
Nov.	738 25	723 88	756 53	621 47	200 37	864 94	144 98	310 25	327 1	388 5	421 1	789 2	308 8	233 0	509 1
Dec.	811 10	584 79	706 19	742 02	206 99	035 82	119 82	426 39	431 7	413 6	535 0	827 6	536 6	328 4	743 6

Tab.III.

Table III. Of the Mean Motions for Days.

Days	Suppl. of ☊				☾				A			
	s	°	′	″	s	°	′	″	s	°	′	″
1	0	0	3	11	0	13	10	35	0	13	3	54
2	0	0	6	21	0	26	21	10	0	26	7	48
3	0	0	9	32	1	9	31	45	1	9	11	42
4	0	0	12	43	1	22	42	20	1	22	15	36
5	0	0	15	53	2	5	52	55	2	5	19	30
6	0	0	19	4	2	19	3	30	2	18	23	24
7	0	0	22	14	3	2	14	5	3	1	27	18
8	0	0	25	25	3	15	24	40	3	14	31	12
9	0	0	28	36	3	28	35	15	3	27	35	6
10	0	0	31	46	4	11	45	50	4	10	39	0
11	0	0	34	57	4	24	56	25	4	23	42	53
12	0	0	38	8	5	8	7	0	5	6	46	47
13	0	0	41	18	5	21	17	35	5	19	50	41
14	0	0	44	29	6	4	28	10	6	2	54	35
15	0	0	47	40	6	17	38	45	6	15	58	29
16	0	0	50	50	7	0	49	20	6	29	2	23
17	0	0	54	1	7	13	59	55	7	12	6	17
18	0	0	57	11	7	27	10	30	7	25	10	11
19	0	1	0	22	8	10	21	5	8	8	14	5
20	0	1	3	33	8	23	31	40	8	21	17	59
21	0	1	6	43	9	6	42	15	9	4	21	53
22	0	1	9	54	9	19	52	50	9	17	25	47
23	0	1	13	5	10	3	3	25	10	0	29	41
24	0	1	16	15	10	16	14	0	10	13	33	35
25	0	1	19	26	10	29	24	36	10	26	37	29
26	0	1	22	37	11	12	35	11	11	9	41	23
27	0	1	25	47	11	25	45	46	11	22	45	17
28	0	1	28	58	0	8	56	21	0	5	49	11
29	0	1	32	9	0	22	6	56	0	18	53	5
30	0	1	35	19	1	5	17	31	1	1	56	59
31	0	1	38	30	1	18	28	6	1	15	0	53

Second

Table III. Of the Mean Motions for Days,

Days	B				C				D			E		
	s	°	′	″	s	°	′	″	s	°	′	s	°	′
1	0	11	18	59	0	12	11	27	0	0	59	0	2	5
2	0	22	37	59	0	24	22	53	0	1	58	0	4	9
3	1	3	56	58	1	6	34	20	0	2	57	0	6	14
4	1	15	15	58	1	18	45	47	0	3	57	0	8	18
5	1	26	34	57	2	0	57	13	0	4	56	0	10	23
6	2	7	53	57	2	13	8	40	0	5	55	0	12	28
7	2	19	12	56	2	25	20	7	0	6	54	0	14	32
8	3	0	31	55	3	7	31	34	0	7	53	0	16	7
9	3	11	50	55	3	19	43	0	0	8	52	0	18	42
10	3	23	9	54	4	1	54	27	0	9	51	0	20	46
11	4	4	28	54	4	14	5	54	0	10	51	0	22	51
12	4	15	47	53	4	26	17	20	0	11	50	0	24	56
13	4	27	6	53	5	8	28	47	0	12	49	0	27	0
14	5	8	25	52	5	20	40	14	0	13	48	0	29	5
15	5	19	44	51	6	2	51	40	0	14	47	1	1	9
16	6	1	3	51	6	15	3	7	0	15	46	1	3	14
17	6	12	22	50	6	27	14	34	0	16	45	1	5	19
18	6	23	41	50	7	9	26	0	0	17	44	1	7	23
19	7	5	0	49	7	21	37	27	0	18	44	1	9	28
20	7	16	19	49	8	3	48	54	0	19	43	1	11	33
21	7	27	38	48	8	16	0	21	0	20	42	1	13	37
22	8	8	57	48	8	28	11	47	0	21	41	1	15	42
23	8	20	16	47	9	10	23	14	0	22	40	1	17	47
24	9	1	35	46	9	22	34	41	0	23	39	1	19	51
25	9	12	54	46	10	4	46	7	0	24	38	1	21	56
26	9	24	13	45	10	16	57	34	0	25	38	1	24	0
27	10	5	32	45	10	29	9	1	0	26	37	1	26	5
28	10	16	51	44	11	11	20	27	0	27	36	1	28	10
29	10	28	10	44	11	23	31	54	0	28	35	2	0	14
30	11	9	29	43	0	5	43	21	0	29	34	2	2	19
31	11	20	48	42	0	17	54	47	1	0	33	2	4	24

Second Part of Table III.

Days	a	b	c	d	e	f
1	002 4	028 7	065 0	104 0	033 6	039 0
2	004 9	057 4	130 0	208 0	067 1	078 1
3	007 3	086 1	195 0	312 1	100 7	117 1
4	009 7	114 8	260 0	416 1	134 2	156 1
5	012 1	143 5	324 0	520 1	167 8	195 1
6	014 6	172 2	390 0	624 1	201 3	234 1
7	017 0	200 9	454 9	728 1	234 9	273 2
8	019 4	229 6	519 9	832 1	268 4	312 2
9	021 9	258 3	584 9	936 2	302 0	351 3
10	024 3	287 0	649 9	040 2	335 5	390 3
11	026 7	315 7	714 9	144 2	369 1	429 3
12	029 1	344 4	779 9	248 2	402 6	468 4
13	031 6	373 1	844 9	352 2	436 2	507 4
14	034 0	401 8	909 8	456 3	469 8	546 4
15	036 4	430 5	974 8	560 3	503 3	585 4
16	038 9	459 2	039 8	664 3	536 9	624 5
17	041 3	487 8	104 8	768 3	570 4	663 5
18	043 7	516 5	169 8	872 3	604 0	702 5
19	046 1	545 2	234 8	976 3	637 5	741 6
20	048 6	573 9	299 8	080 4	671 1	780 6
21	051 0	602 6	364 8	184 4	704 6	819 6
22	053 4	631 3	429 7	288 4	738 2	858 6
23	055 9	660 0	494 7	392 4	771 7	897 7
24	058 3	688 7	559 7	496 4	805 3	936 7
25	060 7	717 4	624 7	600 5	838 8	975 7
26	063 1	746 1	689 7	704 5	872 4	014 8
27	065 6	774 8	754 7	808 5	906 0	053 8
28	068 0	803 5	819 7	912 5	939 5	092 8
29	070 4	832 2	884 7	016 5	973 1	131 9
30	072 9	860 9	949 6	120 5	006 6	170 9
31	075 3	889 6	014 6	224 6	040 2	209 9

Second Part of Table III.

Days	g	h	i	k	l	m	n	o	p
1	099 2	037 2	070	034	070	101	008	070	041
2	198 3	074 4	140	068	141	203	015	140	082
3	297 5	111 6	210	103	211	304	023	210	123
4	396 6	148 8	281	137	282	405	030	279	165
5	495 8	186 0	351	171	352	506	038	349	206
6	595 0	223 2	421	205	423	608	046	419	247
7	694 1	260 4	491	239	493	709	053	489	288
8	793 3	297 6	561	273	564	810	061	559	329
9	892 5	334 8	631	308	634	912	068	629	370
10	991 6	372 0	702	342	705	013	076	698	411
11	090 8	409 3	772	376	775	114	084	768	453
12	189 9	446 5	842	410	846	215	091	838	494
13	289 1	483 7	912	444	916	317	099	908	535
14	388 3	520 9	982	478	986	418	106	978	576
15	487 4	558 1	052	513	057	519	114	048	617
16	586 6	595 3	122	547	127	620	122	118	658
17	685 7	632 5	193	581	198	722	129	187	700
18	784 9	669 7	263	615	268	823	137	257	741
19	884 1	706 9	333	649	339	924	144	327	782
20	983 2	744 1	403	683	409	026	152	397	823
21	082 4	781 3	473	718	480	127	159	467	864
22	181 5	818 5	543	752	550	228	167	537	905
23	280 7	855 7	614	786	621	329	175	606	946
24	379 9	892 9	684	820	691	431	182	676	988
25	479 0	930 1	754	854	762	532	190	746	029
26	578 2	967 3	824	888	832	633	197	816	070
27	677 4	004 5	894	923	903	735	205	886	111
28	776 5	041 7	964	957	973	836	213	956	152
29	875 7	078 9	034	991	043	937	220	026	193
30	974 8	116 1	105	025	114	038	228	095	234
31	074 0	153 3	175	059	184	140	235	165	276

Table IV. Mean Motions for Hours.

Hours	Supl. of ☊	☾	A	B	C	D	E
1	0ſ 0° 0′ 8″	0ſ 0° 32′ 56″	0ſ 0° 32′ 40″	0ſ 0° 28′ 17″	0ſ 0° 30′ 29″	0ſ 0° 2′	0ſ 0° 5′
2	0 0 0 16	0 1 5 53	0 1 5 19	0 0 56 35	0 1 0 57	0 0 5	0 0 10
3	0 0 0 24	0 1 38 49	0 1 37 59	0 1 24 52	0 1 31 26	0 0 7	0 0 16
4	0 0 0 32	0 2 11 46	0 2 10 39	0 1 53 10	0 2 1 54	0 0 10	0 0 21
5	0 0 0 40	0 2 44 42	0 2 43 19	0 2 21 27	0 2 32 23	0 0 12	0 0 26
6	0 0 0 48	0 3 17 39	0 3 15 58	0 2 49 45	0 3 2 52	0 0 15	0 0 31
7	0 0 0 56	0 3 50 35	0 3 48 38	0 3 18 2	0 3 33 20	0 0 17	0 0 36
8	0 0 1 4	0 4 23 32	0 4 21 18	0 3 46 20	0 4 3 49	0 0 20	0 0 42
9	0 0 1 12	0 4 56 28	0 4 53 58	0 4 14 37	0 4 34 18	0 0 22	0 0 47
10	0 0 1 19	0 5 29 24	0 5 26 37	0 4 42 55	0 5 4 46	0 0 25	0 0 52
11	0 0 1 27	0 6 2 21	0 5 59 17	0 5 11 12	0 5 35 15	0 0 27	0 0 57
12	0 0 1 35	0 6 35 18	0 6 31 57	0 5 39 30	0 6 5 43	0 0 30	0 1 2
13	0 0 1 43	0 7 8 14	0 7 4 37	0 6 7 47	0 6 36 12	0 0 32	0 1 7
14	0 0 1 51	0 7 41 10	0 7 37 16	0 6 36 5	0 7 6 41	0 0 34	0 1 13
15	0 0 1 59	0 8 14 7	0 8 9 56	0 7 4 22	0 7 37 9	0 0 37	0 1 18
16	0 0 2 7	0 8 47 3	0 8 42 36	0 7 32 40	0 8 7 38	0 0 39	0 1 23
17	0 0 2 15	0 9 20 0	0 9 15 16	0 8 0 57	0 8 38 6	0 0 42	0 1 28
18	0 0 2 23	0 9 52 56	0 9 47 55	0 8 29 15	0 9 8 35	0 0 44	0 1 33
19	0 0 2 31	0 10 25 53	0 10 20 35	0 8 57 32	0 9 39 4	0 0 47	0 1 39
20	0 0 2 39	0 10 58 49	0 10 53 15	0 9 25 50	0 10 9 32	0 0 49	0 1 44
21	0 0 2 47	0 11 31 46	0 11 25 55	0 9 54 7	0 10 40 1	0 0 52	0 1 49
22	0 0 2 55	0 12 4 42	0 11 58 34	0 10 22 24	0 11 10 30	0 0 54	0 1 54
23	0 0 3 3	0 12 37 39	0 12 31 14	0 10 50 42	0 11 40 58	0 0 57	0 1 59
24	0 0 3 11	0 13 10 35	0 13 3 54	0 11 18 59	0 12 11 27	0 0 59	0 2 5

Second Part of Table IV.

Hours	a		b		c		d		e		f		g		h		i	k	l	m	n	o	p
1	0	1	1	2	2	7	4	3	1	4	1	6	4	1	1	5	3	1	3	4	0	3	2
2	0	2	2	4	5	4	8	7	2	8	3	3	8	3	3	1	6	3	6	8	1	6	3
3	0	3	3	6	8	1	13	0	4	2	4	9	12	4	4	6	9	4	9	13	1	9	5
4	0	4	4	8	10	8	17	3	5	6	6	5	16	6	6	2	12	6	12	17	1	12	7
5	0	5	6	0	13	5	21	7	7	0	8	1	20	7	7	7	15	7	15	21	2	15	9
6	0	6	7	2	16	3	26	0	8	4	9	8	24	8	9	3	18	9	18	25	2	17	10
7	0	7	8	4	19	0	30	3	9	8	11	4	28	9	10	8	20	10	21	30	2	20	12
8	0	8	9	6	21	7	34	7	11	2	13	0	33	1	12	4	23	11	23	34	3	23	14
9	0	9	10	8	24	4	39	0	12	6	14	6	37	2	14	0	26	13	26	38	3	26	15
10	1	0	12	0	27	1	43	3	14	0	16	3	41	3	15	5	29	14	29	42	3	29	17
11	1	1	13	2	29	8	47	7	15	4	17	9	45	4	17	1	32	16	32	46	3	32	19
12	1	2	14	3	32	5	52	0	16	8	19	5	49	6	18	6	35	17	35	51	4	35	21
13	1	3	15	5	35	2	56	3	18	2	21	1	53	7	20	2	38	19	38	55	4	38	22
14	1	4	16	7	37	9	60	7	19	6	22	8	57	8	21	7	41	20	41	59	4	41	24
15	1	5	17	9	40	6	65	0	21	0	24	4	62	0	23	3	44	21	44	63	5	44	26
16	1	6	19	1	43	3	69	3	22	4	26	0	66	1	24	8	47	23	47	68	5	47	27
17	1	7	20	3	46	0	73	7	23	8	27	6	70	2	26	4	50	24	50	72	5	49	29
18	1	8	21	5	48	7	78	0	25	2	29	3	74	4	27	9	53	26	53	76	6	52	31
19	1	9	22	7	51	4	82	3	26	6	30	9	78	5	29	5	56	27	56	80	6	55	33
20	2	0	23	9	54	2	86	7	28	0	32	5	82	6	31	0	58	29	59	84	6	58	34
21	2	1	25	1	56	9	91	0	29	4	34	1	86	8	32	6	61	31	62	89	7	61	36
22	2	2	26	3	59	6	95	3	30	8	35	8	90	9	34	1	64	32	65	93	7	64	38
23	2	3	27	5	62	3	99	7	32	2	37	4	95	0	35	7	67	34	68	97	7	67	39

Table V. The Mean Motions for Minutes.

Minutes	Sup. of ☊	☾		A		B		C		D	E
	″	′	″	′	″	′	″	′	″	′	′
1	0	0	33	0	33	0	28	0	30	0	0
2	0	1	6	1	5	0	57	1	1	0	0
3	0	1	39	1	38	1	25	1	31	0	0
4	1	2	12	2	11	1	53	2	2	0	0
5	1	2	45	2	43	2	21	2	32	0	0
6	1	3	18	3	16	2	50	3	3	0	1
7	1	3	51	3	49	3	18	3	33	0	1
8	1	4	24	4	21	3	46	4	4	0	1
9	1	4	56	4	54	4	15	4	34	0	1
10	1	5	29	5	27	4	43	5	5	0	1
11	1	6	2	5	59	5	11	5	35	0	1
12	2	6	35	6	32	5	39	6	6	0	1
13	2	7	8	7	5	6	8	6	36	1	1
14	2	7	41	7	37	6	36	7	7	1	1
15	2	8	14	8	10	7	4	7	37	1	1
16	2	8	47	8	43	7	33	8	8	1	1
17	2	9	20	9	15	8	1	8	38	1	1
18	2	9	53	9	48	8	29	9	9	1	2
19	3	10	26	10	21	8	58	9	39	1	2
20	3	10	59	10	53	9	26	10	10	1	2
21	3	11	32	11	26	9	54	10	40	1	2
22	3	12	5	11	59	10	22	11	10	1	2
23	3	12	38	12	31	10	51	11	41	1	2
24	3	13	11	13	4	11	19	12	11	1	2
25	3	13	44	13	37	11	47	12	42	1	2
26	3	14	16	14	9	12	16	13	12	1	2
27	4	14	49	14	42	12	44	13	43	1	2
28	4	15	22	15	15	13	12	14	13	1	2
29	4	15	55	15	47	13	40	14	44	1	3
30	4	16	28	16	20	14	9	15	14	1	3

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Continuation of Table V.

Minutes	Sup. of 68	☾		A		B		C		D	E
	″	′	″	′	″	′	″	′	″	′	′
31	4	17	1	16	53	14	37	15	45	1	3
32	4	17	34	17	25	15	5	16	15	1	3
33	4	18	7	17	58	15	34	16	46	1	3
34	4	18	40	18	31	16	2	17	16	2	3
35	5	19	13	19	3	16	30	17	47	2	3
36	5	19	46	19	36	16	58	18	17	2	3
37	5	20	19	20	9	17	27	18	48	2	3
38	5	20	52	20	41	17	55	19	18	2	3
39	5	21	25	21	14	18	23	19	49	2	3
40	5	21	58	21	46	18	52	20	19	2	3
41	5	22	31	22	19	19	20	20	50	2	4
42	6	23	4	22	52	19	48	21	20	2	4
43	6	23	36	23	24	20	17	21	51	2	4
44	6	24	9	23	57	20	45	22	21	2	4
45	6	24	42	24	30	21	13	22	51	2	4
46	6	25	15	25	2	21	41	23	22	2	4
47	6	25	48	25	35	22	10	23	52	2	4
48	6	26	21	26	8	22	38	24	23	2	4
49	6	26	54	26	40	23	6	24	53	2	4
50	7	27	27	27	13	23	35	25	24	2	4
51	7	28	0	27	46	24	3	25	54	2	4
52	7	28	33	28	18	24	31	26	25	2	4
53	7	29	6	28	51	24	59	26	55	2	5
54	7	29	39	29	24	25	28	27	26	2	5
55	7	30	12	29	56	25	55	27	56	2	5
56	7	30	45	30	29	26	24	28	27	2	5
57	8	31	18	31	2	26	53	28	57	2	5
58	8	31	51	31	34	27	21	29	28	2	5
59	8	32	24	32	7	27	49	29	58	2	5
60	8	32	56	32	40	28	17	30	29	2	5

Second Part of Table V.

Min.	a	b	c	d	e	f	g	h	i	k	l	m	n	o	p
1	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0	0	0	0	0	0	0
3	0.0	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0	0	0	0	0	0	0
5	0.0	0.1	0.2	0.3	0.1	0.1	0.3	0.1	0	0	0	0	0	0	0
7	0.0	0.1	0.3	0.5	0.2	0.2	0.5	0.2	0	0	0	0	0	0	0
9	0.0	0.2	0.4	0.6	0.2	0.2	0.6	0.2	0	0	0	1	0	0	0
11	0.0	0.2	0.5	0.8	0.3	0.3	0.8	0.3	0	0	0	1	0	0	0
13	0.0	0.3	0.6	0.9	0.3	0.4	0.9	0.3	1	0	1	1	0	1	0
15	0.0	0.3	0.7	1.1	0.3	0.4	1.0	0.4	1	0	1	1	0	1	0
17	0.0	0.3	0.8	1.2	0.4	0.5	1.2	0.4	1	0	1	1	0	1	0
19	0.0	0.4	0.8	1.4	0.4	0.5	1.3	0.5	1	0	1	1	0	1	1
21	0.0	0.4	0.9	1.5	0.5	0.6	1.4	0.5	1	0	1	1	0	1	1
23	0.0	0.5	1.0	1.6	0.5	0.6	1.6	0.6	1	1	1	2	0	1	1
25	0.0	0.5	1.1	1.8	0.6	0.7	1.7	0.6	1	1	1	2	0	1	1
27	0.0	0.5	1.2	1.9	0.6	0.7	1.9	0.7	1	1	1	2	0	1	1
29	0.0	0.6	1.3	2.1	0.7	0.8	2.0	0.7	1	1	1	2	0	1	1
31	0.0	0.6	1.4	2.2	0.7	0.8	2.1	0.8	2	1	1	2	0	1	1
33	0.1	0.7	1.5	2.4	0.8	0.9	2.3	0.9	2	1	2	2	0	2	1
35	0.1	0.7	1.6	2.5	0.8	0.9	2.4	0.9	2	1	2	2	0	2	1
37	0.1	0.7	1.7	2.7	0.9	1.0	2.5	1.0	2	1	2	3	0	2	1
39	0.1	0.8	1.7	2.8	0.9	1.1	2.7	1.0	2	1	2	3	0	2	1
41	0.1	0.8	1.8	3.0	1.0	1.1	2.8	1.1	2	1	2	3	0	2	1
43	0.1	0.9	1.9	3.1	1.0	1.2	3.0	1.1	2	1	2	3	0	2	1
45	0.1	0.9	2.0	3.2	1.0	1.2	3.1	1.2	2	1	2	3	0	2	1
47	0.1	0.9	2.1	3.4	1.1	1.3	3.2	1.2	2	1	2	3	0	2	1
49	0.1	1.0	2.2	3.5	1.1	1.3	3.4	1.3	2	1	2	3	0	2	1
51	0.1	1.0	2.3	3.7	1.2	1.4	3.5	1.3	2	1	2	4	0	2	1
53	0.1	1.1	2.4	3.8	1.2	1.4	3.6	1.4	2	1	3	4	0	3	1
55	0.1	1.1	2.5	4.0	1.3	1.5	3.8	1.4	3	1	3	4	0	3	2
57	0.1	1.1	2.6	4.1	1.3	1.5	3.9	1.5	3	1	3	4	0	3	2
59	0.1	1.2	2.7	4.3	1.4	1.6	4.1	1.5	3	1	3	4	0	3	2

Table VI. The Mean Motions for Seconds.

Seconds	☾	A	B	C
	″	″	″	″
1	1	1	0	1
3	2	2	1	2
5	3	3	2	3
7	4	4	3	4
9	5	5	4	5
11	6	6	5	6
13	7	7	6	7
15	8	8	7	8
17	9	9	8	9
19	10	10	9	10
21	12	11	10	11
23	13	13	11	12
25	14	14	12	13
27	15	15	13	14
29	16	16	14	15
31	17	17	15	16
33	18	18	16	17
35	19	19	16	18
37	20	20	17	19
39	21	21	18	20
41	23	22	19	21
43	24	23	20	22
45	25	24	21	23
47	26	26	22	24
49	27	27	23	25
51	28	28	24	26
53	29	29	25	27
55	30	30	26	28
57	31	31	27	29
59	32	32	28	30

TABLE VII.

The EQUATION of the CENTER.

Argum.	SIGNS.														
A.	O			diff.		I.			diff.		II.			diff.	
	°	′	″	′	″	°	′	″	′	″	°	′	″	′	″
0	7	0	0	6	10	4	1	56	5	27	1	44	25	3	26
1	6	53	50	6	10	3	56	29	5	24	1	40	59	3	21
2	6	47	40	6	10	3	51	5	5	22	1	37	38	3	17
3	6	41	30	6	9	3	45	43	5	19	1	34	21	3	11
4	6	35	21	6	9	3	40	24	5	16	1	31	10	3	5
5	6	29	12	6	9	3	35	8	5	12	1	28	5	2	59
6	6	23	3	6	8	3	29	56	5	8	1	25	6	2	54
7	6	16	55	6	7	3	24	48	5	6	1	22	12	2	49
8	6	10	48	6	6	3	19	42	5	3	1	19	23	2	43
9	6	4	42	6	6	3	14	39	5	0	1	16	40	2	37
10	5	58	36	6	5	3	9	39	4	56	1	14	3	2	32
11	5	52	31	6	3	3	4	43	4	51	1	11	31	2	25
12	5	46	28	6	3	2	59	52	4	47	1	9	6	2	20
13	5	40	25	6	2	2	55	5	4	43	1	6	46	2	14
14	5	34	23	6	0	2	50	22	4	40	1	4	32	2	7
15	5	28	23	5	59	2	45	42	4	36	1	2	25	2	1
16	5	22	24	5	57	2	41	6	4	33	1	0	24	1	56
17	5	16	27	5	55	2	36	33	4	28	0	58	28	1	48
18	5	10	32	5	55	2	32	5	4	23	0	56	40	1	42
19	5	4	37	5	53	2	27	42	4	18	0	54	58	1	36
20	4	58	44	5	51	2	23	24	4	15	0	53	22	1	30
21	4	52	53	5	49	2	19	9	4	11	0	51	52	1	24
22	4	47	4	5	47	2	14	58	4	6	0	50	28	1	17
23	4	41	17	5	44	2	10	52	4	1	0	49	11	1	11
24	4	35	33	5	42	2	6	51	3	57	0	48	0	1	3
25	4	29	51	5	41	2	2	54	3	52	0	46	57	0	57
26	4	24	10	5	38	1	59	2	3	47	0	46	0	0	51
27	4	18	32	5	35	1	55	15	3	41	0	45	9	0	45
28	4	12	57	5	32	1	51	34	3	37	0	44	24	0	38
29	4	7	25	5	29	1	47	57	3	32	0	43	46	0	30
30	4	1	56			1	44	25			0	43	16		

TABLE VII

TABLE VII.

The EQUATION of the CENTER.

Argum. A.	SIGNS.					
	III.	diff.	IV.	diff.	V.	diff.
	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″
0	0 43 16	0 23	1 21 59	3 4	3 39 28	5 58
1	0 42 53	0 17	1 25 3	3 12	3 45 26	6 2
2	0 42 36	0 11	1 28 15	3 20	3 51 28	6 6
3	0 42 25	0 3	1 31 35	3 26	3 57 34	6 11
4	0 42 22	0 4	1 35 1	3 33	4 3 45	6 14
5	0 42 26	0 11	1 38 34	3 39	4 9 59	6 18
6	0 42 37	0 18	1 42 13	3 45	4 16 17	6 22
7	0 42 55	0 24	1 45 58	3 51	4 22 39	6 25
8	0 43 19	0 32	1 49 49	3 58	4 29 4	6 29
9	0 43 51	0 38	1 53 47	4 5	4 35 33	6 32
10	0 44 29	0 46	1 57 52	4 11	4 42 5	6 35
11	0 45 15	0 52	2 2 3	4 16	4 48 40	6 37
12	0 46 7	0 59	2 6 19	4 23	4 55 17	6 40
13	0 47 6	1 7	2 10 42	4 30	5 1 57	6 42
14	0 48 13	1 14	2 15 12	4 35	5 8 39	6 45
15	0 49 27	1 22	2 19 47	4 41	5 15 24	6 48
16	0 50 49	1 29	2 24 28	4 46	5 22 12	6 51
17	0 52 18	1 35	2 29 14	4 53	5 29 3	6 52
18	0 53 53	1 41	2 34 7	4 58	5 35 55	6 54
19	0 55 34	1 49	2 39 5	5 4	5 42 49	6 56
20	0 57 23	1 57	2 44 9	5 9	5 49 45	6 57
21	0 59 20	2 3	2 49 18	5 15	5 56 42	6 58
22	1 1 23	2 10	2 54 33	5 20	6 3 40	6 59
23	1 3 33	2 17	2 59 53	5 25	6 10 39	7 1
24	1 5 50	2 24	3 5 18	5 30	6 17 40	7 2
25	1 8 14	2 31	3 10 48	5 35	6 24 42	7 2
26	1 10 45	2 38	3 16 23	5 39	6 31 44	7 3
27	1 13 23	2 46	3 22 2	5 44	6 38 47	7 4
28	1 16 9	2 52	3 27 46	5 49	6 45 51	7 4
29	1 19 1	2 58	3 33 35	5 53	6 52 55	7 5
30	1 21 59		3 39 28		7 0 0	

TABLE VII.

The EQUATION of the CENTER.

Argum. A.	SIGNS.														
	VI.			diff.		VII.			diff.		VIII.			diff.	
	°	'	"	'	"	°	'	"	'	"	°	'	"	'	"
0	7	0	0	7	5	10	20	32	5	53	12	38	1	2	58
1	7	7	5	7	4	10	26	25	5	49	12	40	59	2	52
2	7	14	9	7	4	10	32	14	5	44	12	43	51	2	46
3	7	21	13	7	3	10	37	58	5	39	12	46	37	2	38
4	7	28	16	7	2	10	43	37	5	35	12	49	15	2	31
5	7	35	18	7	2	10	49	12	5	30	12	51	46	2	24
6	7	42	20	7	1	10	54	42	5	25	12	54	10	2	17
7	7	49	21	6	59	11	0	7	5	20	12	56	27	2	10
8	7	56	20	6	58	11	5	27	5	15	12	58	37	2	3
9	8	3	18	6	57	11	10	42	5	9	13	0	40	1	57
10	8	10	15	6	56	11	15	51	5	4	13	2	37	1	49
11	8	17	11	6	54	11	20	55	4	58	13	4	26	1	41
12	8	24	5	6	52	11	25	53	4	53	13	6	7	1	35
13	8	30	57	6	51	11	30	46	4	46	13	7	42	1	29
14	8	37	48	6	48	11	35	32	4	41	13	9	11	1	22
15	8	44	36	6	45	11	40	13	4	35	13	10	33	1	14
16	8	51	21	6	42	11	44	48	4	30	13	11	47	1	7
17	8	58	3	6	40	11	49	18	4	23	13	12	54	0	59
18	9	4	43	6	37	11	53	41	4	16	13	13	53	0	52
19	9	11	20	6	35	11	57	57	4	11	13	14	45	0	46
20	9	17	55	6	32	12	2	8	4	5	13	15	31	0	38
21	9	24	27	6	29	12	6	13	3	58	13	16	9	0	32
22	9	30	56	6	25	12	10	11	3	51	13	16	41	0	24
23	9	37	21	6	22	12	14	2	3	45	13	17	5	0	18
24	9	43	43	6	18	12	17	47	3	39	13	17	23	0	11
25	9	50	1	6	14	12	21	26	3	33	13	17	34	0	4
26	9	56	15	6	11	12	24	59	3	26	13	17	38	0	3
27	10	2	26	6	6	12	28	25	3	20	13	17	35	0	11
28	10	8	32	6	2	12	31	45	3	12	13	17	24	0	17
29	10	14	34	5	58	12	34	57	3	4	13	17	7	0	23
30	10	20	32			12	38	1			13	16	44		

TABLE VII.

The EQUATION of the CENTER.

Argum. A.	SIGNS. IX.			diff.		X.			diff.		XI.			diff.	
	°	'	"	'	"	°	'	"	'	"	°	'	"	'	"
0	13	16	44	0	30	12	15	35	3	32	9	58	4	5	29
1	13	16	14	0	38	12	12	3	3	37	9	52	35	5	32
2	13	15	36	0	45	12	8	26	3	41	9	47	3	5	35
3	13	14	51	0	51	12	4	45	3	47	9	41	28	5	38
4	13	14	0	0	57	12	0	58	3	52	9	35	50	5	41
5	13	13	3			11	57	6			9	30	9		
—				1	3				3	57				5	42
6	13	12	0	1	11	11	53	9	4	1	9	24	27	5	44
7	13	10	49	1	17	11	49	8	4	6	9	18	43	5	47
8	13	9	22	1	24	11	45	2	4	11	9	12	56	5	49
9	13	8	8	1	30	11	40	51	4	15	9	7	7	5	51
10	13	6	38			11	36	36			9	1	16		
—				1	36				4	18				5	53
11	13	5	2	1	42	11	32	18	4	23	8	55	23	5	55
12	13	3	20	1	48	11	27	55	4	28	8	49	28	5	55
13	13	1	32	1	56	11	23	27	4	33	8	43	33	5	57
14	12	59	36	2	1	11	18	54	4	36	8	37	36	5	59
15	12	57	35			11	14	18			8	31	37		
—				2	7				4	40				6	0
16	12	55	28	2	14	11	9	38	4	43	8	25	37	6	2
17	12	53	14	2	20	11	4	55	4	47	8	19	35	6	3
18	12	50	54	2	25	11	0	8	4	51	8	13	32	6	3
19	12	48	29	2	32	10	55	17	4	56	8	7	29	6	5
20	12	45	57			10	50	21			8	1	24		
—				2	37				5	0				6	6
21	12	43	20	2	43	10	45	21	5	3	7	55	18	6	6
22	12	40	37	2	49	10	40	18	5	6	7	49	12	6	7
23	12	37	48	2	54	10	35	12	5	8	7	43	5	6	8
24	12	34	54	2	59	10	30	4	5	12	7	36	57	6	9
25	12	31	55			10	24	52			7	30	48		
—				3	5				5	16				6	9
26	12	28	50	3	11	10	19	36	5	19	7	24	39	6	9
27	12	25	39	3	17	10	14	17	5	22	7	18	30	6	10
28	12	22	22	3	21	10	8	55	5	24	7	12	20	6	10
29	12	19	1	3	26	10	3	31	5	27	7	6	10	6	10
30	12	15	35			9	58	4			7	0	0		

TABLE VIII.

TABLE VIII.

The Evection.

Argum. B	SIGNS. O	diff.	SIGNS. I.	diff.	SIGNS. II.	diff.
	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″
0	2 0 0	1 19	1 22 19	1 8	0 54 23	0 39
1	1 58 41	1 19	1 21 11	1 7	0 53 44	0 39
2	1 57 22	1 19	1 20 4	1 7	0 53 5	0 38
3	1 56 3	1 18	1 18 57	1 6	0 52 27	0 36
4	1 54 45	1 18	1 17 51	1 6	0 51 51	0 36
5	1 53 27	1 18	1 16 45	1 5	0 51 15	0 33
6	1 52 9	1 18	1 15 40	1 4	0 50 42	0 33
7	1 50 51	1 18	1 14 36	1 3	0 50 9	0 32
8	1 49 33	1 18	1 13 33	1 2	0 49 37	0 30
9	1 48 15	1 18	1 12 31	1 2	0 49 7	0 28
10	1 46 57	1 18	1 11 29	1 0	0 48 39	0 28
11	1 45 39	1 17	1 10 29	1 0	0 48 11	0 26
12	1 44 22	1 17	1 9 29	0 59	0 47 45	0 26
13	1 43 5	1 17	1 8 30	0 58	0 47 19	0 23
14	1 41 48	1 16	1 7 32	0 56	0 46 56	0 22
15	1 40 32	1 16	1 6 36	0 56	0 46 34	0 22
16	1 39 16	1 16	1 5 40	0 55	0 46 12	0 19
17	1 38 0	1 15	1 4 45	0 54	0 45 53	0 18
18	1 36 45	1 15	1 3 51	0 54	0 45 35	0 17
19	1 35 30	1 14	1 2 57	0 52	0 45 18	0 16
20	1 34 16	1 14	1 2 5	0 51	0 45 2	0 14
21	1 33 1	1 13	1 1 14	0 50	0 44 48	0 13
22	1 31 48	1 13	1 0 24	0 49	0 44 35	0 11
23	1 30 35	1 13	0 59 35	0 47	0 44 24	0 11
24	1 29 22	1 12	0 58 48	0 47	0 44 13	0 9
25	1 28 10	1 11	0 58 1	0 45	0 44 4	0 7
26	1 26 59	1 11	0 57 16	0 45	0 43 57	0 6
27	1 25 48	1 10	0 56 31	0 44	0 43 51	0 5
28	1 24 38	1 10	0 55 47	0 43	0 43 46	0 3
29	1 23 28	1 9	0 55 4	0 41	0 43 43	0 2
30	1 22 19		0 54 23		0 43 41	

TABLE VIII.

The EVECTION.

Argum. B	SIGNS.					
	III.	diff.	IV.	diff.	V.	diff.
	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″
0	0 43 41	0 2	0 53 26	0 40	1 21 22	1 9
1	0 43 39	0 2	0 54 6	0 41	1 22 31	1 11
2	0 43 41	0 3	0 54 47	0 42	1 23 42	1 11
3	0 43 44	0 4	0 55 29	0 44	1 24 53	1 13
4	0 43 48	0 5	0 56 13	0 44	1 26 6	1 13
5	0 43 53	0 6	0 56 57	0 46	1 27 19	1 14
6	0 43 59	0 8	0 57 43	0 48	1 28 33	1 14
7	0 44 7	0 10	0 58 31	0 49	1 29 47	1 15
8	0 44 17	0 11	0 59 20	0 49	1 31 2	1 15
9	0 44 28	0 12	1 0 9	0 51	1 32 17	1 15
10	0 44 40	0 13	1 1 0	0 51	1 33 32	1 17
11	0 44 53	0 14	1 1 51	0 53	1 34 49	1 17
12	0 45 7	0 16	1 2 44	0 54	1 36 6	1 17
13	0 45 23	0 18	1 3 38	0 55	1 37 23	1 17
14	0 45 41	0 19	1 4 33	0 56	1 38 40	1 18
15	0 46 0	0 20	1 5 29	0 57	1 39 58	1 18
16	0 46 20	0 22	1 6 26	0 58	1 41 16	1 19
17	0 46 42	0 24	1 7 24	0 59	1 42 35	1 19
18	0 47 6	0 24	1 8 23	1 0	1 43 54	1 19
19	0 47 30	0 26	1 9 23	1 1	1 45 13	1 20
20	0 47 56	0 27	1 10 24	1 2	1 46 33	1 20
21	0 48 23	0 28	1 11 26	1 3	1 47 53	1 20
22	0 48 51	0 30	1 12 29	1 3	1 49 13	1 20
23	0 49 21	0 31	1 13 32	1 5	1 50 33	1 21
24	0 49 52	0 33	1 14 37	1 5	1 51 54	1 21
25	0 50 25	0 33	1 15 42	1 6	1 53 15	1 21
26	0 50 58	0 35	1 16 48	1 8	1 54 36	1 21
27	0 51 33	0 36	1 17 56	1 8	1 55 57	1 21
28	0 52 9	0 37	1 19 4	1 9	1 57 18	1 21
29	0 52 46	0 40	1 20 13	1 9	1 58 39	1 21
30	0 53 26		1 21 22		2 0 0	

TABLE VIII.

The EVECTION.

Argum. B	SIGNS.														
	VI.			diff.		VII.			diff.		VIII.			diff.	
	°	′	″	′	″	°	′	″	′	″	°	′	″	′	″
0	2	0	0	1	21	2	38	38	1	9	3	6	34	0	40
1	2	1	21	1	21	2	39	47	1	9	3	7	14	0	37
2	2	2	42	1	21	2	40	56	1	8	3	7	51	0	36
3	2	4	3	1	21	2	42	4	1	8	3	8	27	0	35
4	2	5	24	1	21	2	43	12	1	6	3	9	2	0	33
5	2	6	45	1	21	2	44	18	1	5	3	9	35	0	33
6	2	8	6	1	21	2	45	23	1	5	3	10	8	0	31
7	2	9	27	1	20	2	46	28	1	3	3	10	39	0	30
8	2	10	47	1	20	2	47	31	1	3	3	11	9	0	28
9	2	12	7	1	20	2	48	34	1	2	3	11	37	0	27
10	2	13	27	1	20	2	49	36	1	1	3	12	4	0	26
11	2	14	47	1	19	2	50	37	1	0	3	12	30	0	24
12	2	16	6	1	19	2	51	37	0	59	3	12	54	0	24
13	2	17	25	1	19	2	52	36	0	58	3	13	18	0	22
14	2	18	44	1	18	2	53	34	0	57	3	13	40	0	20
15	2	20	2	1	18	2	54	31	0	56	3	14	0	0	19
16	2	21	20	1	17	2	55	27	0	55	3	14	19	0	18
17	2	22	37	1	17	2	56	22	0	54	3	14	37	0	16
18	2	23	54	1	17	2	57	16	0	53	3	14	53	0	14
19	2	25	11	1	17	2	58	9	0	51	3	15	7	0	13
20	2	26	28	1	15	2	59	0	0	51	3	15	20	0	12
21	2	27	43	1	15	2	59	51	0	49	3	15	32	0	11
22	2	28	58	1	15	3	0	40	0	48	3	15	43	0	10
23	2	30	13	1	14	3	1	28	0	48	3	15	53	0	8
24	2	31	27	1	14	3	2	16	0	47	3	16	1	0	6
25	2	32	41	1	13	3	3	3	0	45	3	16	7	0	5
26	2	33	54	1	13	3	3	48	0	43	3	16	12	0	4
27	2	35	7	1	11	3	4	31	0	42	3	16	16	0	3
28	2	36	18	1	11	3	5	13	0	41	3	16	19	0	2
29	2	37	29	1	9	3	5	54	0	40	3	16	21	0	2
30	2	38	38			3	6	34			3	16	19		

TABLE VIII.

The EVECTION.

Argum. B.	SIGNS.														
	IX.			diff.		X.			diff.		XI.			diff.	
	°	′	″	′	″	°	′	″	′	″	°	′	″	′	″
0	3	16	19	0	2	3	5	37	0	41	2	37	41	1	9
1	3	16	17	0	3	3	4	56	0	43	2	36	32	1	10
2	3	16	14	0	5	3	4	13	0	44	2	35	22	1	10
3	3	16	9	0	6	3	3	29	0	45	2	34	12	1	11
4	3	16	3	0	7	3	2	44	0	45	2	33	1	1	11
5	3	15	56	0	9	3	1	59	0	47	2	31	50	1	12
6	3	15	47	0	9	3	1	12	0	47	2	30	38	1	13
7	3	15	36	0	11	3	0	25	0	49	2	29	25	1	13
8	3	15	25	0	13	2	59	36	0	50	2	28	12	1	13
9	3	15	12	0	14	2	58	46	0	51	2	26	59	1	14
10	3	14	58	0	16	2	57	55	0	52	2	25	45	1	15
11	3	14	42	0	17	2	57	3	0	54	2	24	30	1	15
12	3	14	25	0	18	2	56	9	0	54	2	23	15	1	15
13	3	14	7	0	20	2	55	15	0	55	2	22	0	1	16
14	3	13	47	0	21	2	54	20	0	56	2	20	44	1	16
15	3	13	26	0	22	2	53	24	0	56	2	19	28	1	16
16	3	13	4	0	24	2	52	28	0	58	2	18	12	1	17
17	3	12	40	0	25	2	51	30	0	59	2	16	55	1	17
18	3	12	15	0	26	2	50	31	1	0	2	15	38	1	17
19	3	11	49	0	28	2	49	31	1	0	2	14	21	1	18
20	3	11	21	0	28	2	48	31	1	2	2	13	3	1	18
21	3	10	53	0	30	2	47	29	1	2	2	11	45	1	18
22	3	10	23	0	32	2	46	27	1	3	2	10	27	1	18
23	3	9	51	0	33	2	45	24	1	4	2	9	9	1	18
24	3	9	18	0	34	2	44	20	1	5	2	7	51	1	18
25	3	8	44	0	35	2	43	15	1	6	2	6	33	1	18
26	3	8	9	0	36	2	42	9	1	6	2	5	15	1	18
27	3	7	33	0	38	2	41	3	1	7	2	3	57	1	19
28	3	6	55	0	39	2	39	56	1	7	2	2	38	1	19
29	3	6	16	0	39	2	38	49	1	8	2	1	19	1	19
30	3	5	37			2	37	41			2	0	0		

TABLE IX.

The VARIATION.

Argum. ☾	SIGNS. O		I.		II.	
	° ′ ″	diff. ′ ″	° ′ ″	diff. ′ ″	° ′ ″	diff. ′ ″
0	0 50 0	1 23	1 23 39	0 36	1 22 7	0 43
1	0 51 23	1 22	1 24 15	0 34	1 21 24	0 47
2	0 52 45	1 22	1 24 49	0 33	1 20 37	0 49
3	0 54 7	1 22	1 25 22	0 30	1 19 48	0 51
4	0 55 29	1 21	1 25 52	0 26	1 18 57	0 54
5	0 56 50	1 21	1 26 18	0 24	1 18 3	0 56
6	0 58 11	1 20	1 26 42	0 21	1 17 7	0 57
7	0 59 31	1 20	1 26 3	0 18	1 16 10	0 59
8	1 0 51	1 19	1 27 21	0 15	1 15 11	1 1
9	1 2 10	1 18	1 27 36	0 12	1 14 10	1 3
10	1 3 28	1 17	1 27 48	0 9	1 13 7	1 5
11	1 4 45	1 15	1 27 57	0 7	1 12 2	1 6
12	1 6 0	1 14	1 28 4	0 4	1 10 56	1 8
13	1 7 14	1 13	1 28 8	0 2	1 9 48	1 9
14	1 8 27	1 12	1 28 10	0 2	1 8 39	1 10
15	1 9 39	1 10	1 28 8	0 5	1 7 29	1 12
16	1 10 49	1 8	1 28 3	0 8	1 6 17	1 13
17	1 11 57	1 6	1 27 55	0 11	1 5 4	1 14
18	1 13 3	1 5	1 27 44	0 13	1 3 50	1 16
19	1 14 8	1 3	1 27 31	0 16	1 2 34	1 16
20	1 15 11	1 1	1 27 15	0 18	1 1 18	1 17
21	1 16 12	0 58	1 26 57	0 22	1 0 1	1 18
22	1 17 10	0 56	1 26 35	0 24	0 58 43	1 19
23	1 18 6	0 55	1 26 11	0 27	0 57 24	1 19
24	1 19 1	0 52	1 25 44	0 30	0 56 5	1 20
25	1 19 53	0 50	1 25 14	0 32	0 54 45	1 20
26	1 20 43	0 48	1 24 42	0 35	0 53 25	1 20
27	1 21 31	0 45	1 24 7	0 38	0 52 5	1 21
28	1 22 16	0 43	1 23 29	0 40	0 50 44	1 21
29	1 22 59	0 40	1 22 49	0 42	0 49 23	1 21
30	1 23 39		1 22 7		0 48 2	

TABLE IX.

The VARIATION.

Argum. B	SIGNS. III.	diff.	SIGNS. IV.	diff.	SIGNS. V.	diff.
	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″
0	0 48 2	1 21	0 14 28	0 40	0 14 24	0 43
1	0 46 41	1 21	0 13 48	0 38	0 15 7	0 46
2	0 45 20	1 20	0 13 10	0 35	0 15 53	0 49
3	0 44 0	1 20	0 12 35	0 33	0 16 42	0 52
4	0 42 40	1 19	0 12 2	0 29	0 17 34	0 54
5	0 41 21	1 19	0 11 33	0 27	0 18 28	0 56
6	0 40 2	1 19	0 11 6	0 25	0 19 24	0 58
7	0 38 43	1 18	0 10 41	0 23	0 20 22	1 0
8	0 37 25	1 18	0 10 18	0 20	0 21 22	1 2
9	0 36 7	1 16	0 9 58	0 15	0 22 24	1 5
10	0 34 51	1 16	0 9 43	0 12	0 23 29	1 7
11	0 33 35	1 15	0 9 31	0 10	0 24 36	1 8
12	0 32 20	1 13	0 9 21	0 8	0 25 44	1 11
13	0 31 7	1 12	0 9 13	0 4	0 26 55	1 12
14	0 29 55	1 11	0 9 9	0 2	0 28 7	1 14
15	0 28 44	1 10	0 9 7	0 0	0 29 21	1 15
16	0 27 34	1 8	0 9 7	0 3	0 30 36	1 17
17	0 26 26	1 6	0 9 10	0 7	0 31 53	1 18
18	0 25 20	1 5	0 9 17	0 10	0 33 11	1 20
19	0 24 15	1 4	0 9 27	0 13	0 34 31	1 21
20	0 23 11	1 2	0 9 40	0 15	0 35 52	1 21
21	0 22 9	0 59	0 9 55	0 19	0 37 13	1 22
22	0 21 10	0 57	0 10 14	0 22	0 38 35	1 23
23	0 20 13	0 56	0 10 36	0 24	0 39 58	1 25
24	0 19 17	0 53	0 11 0	0 27	0 41 23	1 25
25	0 18 24	0 52	0 11 27	0 30	0 42 48	1 26
26	0 17 32	0 50	0 11 57	0 33	0 44 14	1 26
27	0 16 42	0 47	0 12 30	0 35	0 45 40	1 26
28	0 15 55	0 45	0 13 5	0 38	0 47 6	1 27
29	0 15 10	0 42	0 13 43	0 41	0 48 33	1 27
30	0 14 28		0 14 24		0 50 0	

TABLE IX.

The VARIATION.

Argum. C.	SIGNS. VI.	diff.	VII.	diff.	VIII.	diff.
	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″
0	0 50 0	1 27	1 25 35	0 42	1 25 33	0 43
1	0 51 27	1 27	1 26 17	0 38	1 24 50	0 45
2	0 52 54	1 26	1 26 55	0 35	1 24 5	0 47
3	0 54 20	1 26	1 27 30	0 33	1 23 18	0 50
4	0 55 46	1 26	1 28 3	0 29	1 22 28	0 52
5	0 57 12	1 25	1 28 32	0 27	1 21 36	0 54
6	0 58 37	1 25	1 28 59	0 25	1 20 42	0 55
7	1 0 2	1 23	1 29 24	0 22	1 19 47	0 57
8	1 1 25	1 22	1 29 46	0 19	1 18 50	0 59
9	1 2 47	1 21	1 30 5	0 15	1 17 51	1 2
10	1 4 8	1 21	1 30 20	0 13	1 16 49	1 4
11	1 5 29	1 20	1 30 33	0 10	1 15 45	1 5
12	1 6 49	1 18	1 30 43	0 7	1 14 40	1 6
13	1 8 7	1 17	1 30 50	0 3	1 13 34	1 8
14	1 9 24	1 16	1 30 53	0 0	1 12 26	1 9
15	1 10 40	1 13	1 30 53	0 2	1 11 17	1 11
16	1 11 53	1 12	1 30 51	0 4	1 10 6	1 12
17	1 13 5	1 10	1 30 47	0 7	1 8 54	1 14
18	1 14 15	1 9	1 30 40	0 10	1 7 40	1 15
19	1 15 24	1 7	1 30 30	0 13	1 6 25	1 16
20	1 16 31	1 5	1 30 17	0 16	1 5 9	1 17
21	1 17 36	1 2	1 30 1	0 19	1 3 52	1 17
22	1 18 38	1 0	1 29 42	0 22	1 2 35	1 18
23	1 19 38	0 58	1 29 20	0 25	1 1 17	1 19
24	1 20 36	0 56	1 28 55	0 27	0 59 58	1 19
25	1 21 32	0 54	1 28 28	0 30	0 58 39	1 19
26	1 22 26	0 52	1 27 58	0 33	0 57 20	1 20
27	1 23 18	0 49	1 27 25	0 35	0 56 0	1 20
28	1 24 7	0 45	1 26 50	0 37	0 54 40	1 21
29	1 24 52	0 43	1 26 13	0 40	0 53 19	1 21
30	1 25 35		1 25 33		0 51 58	

TABLE IX.

The VARIATION.

Argum. C.	SIGNS.					
	IX.	diff.	X.	diff.	XI.	diff.
	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″
0	0 51 58	1 21	0 17 53	0 42	0 16 22	0 39
1	0 50 37	1 21	0 17 11	0 40	0 17 1	0 43
2	0 49 16	1 21	0 16 31	0 38	0 17 44	0 45
3	0 47 55	1 20	0 15 53	0 35	0 18 29	0 48
4	0 46 35	1 20	0 15 18	0 32	0 19 17	0 50
5	0 45 15	1 20	0 14 46	0 30	0 20 7	0 52
6	0 43 55	1 19	0 14 16	0 27	0 20 59	0 55
7	0 42 36	1 19	0 13 49	0 24	0 21 54	0 56
8	0 41 17	1 18	0 13 25	0 22	0 22 50	0 58
9	0 39 59	1 17	0 13 3	0 18	0 23 48	1 1
10	0 38 42	1 16	0 12 45	0 16	0 24 49	1 3
11	0 37 26	1 15	0 12 29	0 13	0 25 52	1 5
12	0 36 11	1 15	0 12 16	0 11	0 26 57	1 6
13	0 34 56	1 13	0 12 5	0 8	0 28 3	1 8
14	0 33 43	1 12	0 11 57	0 5	0 29 11	1 10
15	0 32 31	1 10	0 11 52	0 2	0 30 21	1 12
16	0 31 21	1 9	0 11 50	0 2	0 31 33	1 13
17	0 30 12	1 8	0 11 52	0 4	0 32 46	1 14
18	0 29 4	1 6	0 11 56	0 7	0 34 0	1 16
19	0 27 58	1 4	0 12 3	0 9	0 35 16	1 16
20	0 26 54	1 3	0 12 12	0 12	0 36 32	1 18
21	0 25 51	1 2	0 12 24	0 15	0 37 50	1 19
22	0 24 49	0 59	0 12 39	0 18	0 39 9	1 20
23	0 23 50	0 57	0 12 57	0 21	0 40 29	1 20
24	0 22 53	0 56	0 13 18	0 24	0 41 49	1 21
25	0 21 57	0 54	0 13 42	0 27	0 43 10	1 21
26	0 21 3	0 51	0 14 9	0 30	0 44 31	1 22
27	0 20 12	0 49	0 14 39	0 32	0 45 53	1 22
28	0 19 23	0 47	0 15 11	0 34	0 47 15	1 22
29	0 18 36	0 43	0 15 45	0 37	0 48 37	1 23
30	0 17 53		0 16 22		0 50 0	

TABLE X.

TABLE X.

The First Solar Equation.

Argum.	SIGNS.						
D	IX.	X.	XI.	O.	I.	II.	
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
0	17 45	19 15	23 22	29 0	34 38	38 45	30
1	17 45	19 21	23 33	29 12	34 47	38 50	29
2	17 45	19 27	23 43	29 24	34 57	38 56	28
3	17 46	19 34	23 54	29 36	35 7	39 2	27
4	17 46	19 40	24 4	29 48	35 17	39 7	26
5	17 47	19 47	24 15	30 0	35 27	39 12	25
6	17 48	19 54	24 26	30 11	35 36	39 17	24
7	17 50	20 1	24 37	30 22	35 46	39 21	23
8	17 52	20 8	24 48	30 34	35 56	39 26	22
9	17 54	20 15	24 59	30 46	36 5	39 30	21
10	17 56	20 23	25 10	30 57	36 14	39 34	20
11	17 58	20 31	25 21	31 9	36 23	39 38	19
12	18 0	20 39	25 32	31 21	36 32	39 42	18
13	18 2	20 47	25 43	31 32	36 41	39 46	17
14	18 5	20 54	25 54	31 44	36 49	39 49	16
15	18 8	21 2	26 5	31 55	36 58	39 52	15
16	18 11	21 11	26 16	32 6	37 6	39 55	14
17	18 14	21 19	26 28	32 17	37 13	39 58	13
18	18 18	21 28	26 39	32 28	37 21	40 0	12
19	18 22	21 37	26 51	32 39	37 29	40 2	11
20	18 26	21 46	27 3	32 50	37 37	40 4	10
21	18 30	21 55	27 14	33 1	37 45	40 6	9
22	18 34	22 4	27 26	33 12	37 52	40 8	8
23	18 39	22 14	27 38	33 23	37 59	40 10	7
24	18 43	22 24	27 49	33 34	38 6	40 12	6
25	18 48	22 33	28 0	33 45	38 13	40 13	5
26	18 53	22 43	28 12	33 56	38 20	40 14	4
27	18 58	22 53	28 24	34 6	38 26	40 14	3
28	19 4	23 3	28 36	34 17	38 33	40 15	2
29	19 10	23 13	28 48	34 27	38 39	40 15	1
30	19 15	23 22	29 0	34 38	38 45	40 15	0
	VIII.	VII.	VI.	V.	IV.	III.	D.
	SIGNS.						

TABLE XI.

TABLE XI.

The Second Solar Equation.

Argum.	SIGNS.						
E	IX.	X.	XI.	O.	I.	II.	
	' "	' "	' "	' "	' "	' "	
0	2 0	1 52	1 30	1 0	0 30	0 8	30
1	2 0	1 51	1 29	0 59	0 29	0 8	29
2	2 0	1 51	1 28	0 58	0 28	0 7	28
3	2 0	1 50	1 27	0 57	0 27	0 7	27
4	2 0	1 50	1 26	0 56	0 26	0 6	26
5	2 0	1 49	1 25	0 55	0 25	0 6	25
6	2 0	1 48	1 24	0 54	0 25	0 5	24
7	1 59	1 48	1 23	0 53	0 24	0 5	23
8	1 59	1 47	1 22	0 52	0 23	0 4	22
9	1 59	1 47	1 21	0 51	0 23	0 4	21
10	1 59	1 46	1 20	0 50	0 22	0 4	20
11	1 59	1 45	1 19	0 49	0 21	0 3	19
12	1 59	1 45	1 18	0 48	0 20	0 3	18
13	1 58	1 44	1 17	0 47	0 19	0 3	17
14	1 58	1 43	1 16	0 46	0 18	0 2	16
15	1 58	1 42	1 15	0 45	0 18	0 2	15
16	1 58	1 42	1 14	0 44	0 17	0 2	14
17	1 57	1 41	1 13	0 43	0 16	0 2	13
18	1 57	1 40	1 12	0 42	0 15	0 1	12
19	1 57	1 39	1 11	0 41	0 15	0 1	11
20	1 56	1 38	1 10	0 40	0 14	0 1	10
21	1 56	1 38	1 9	0 39	0 13	0 1	9
22	1 56	1 37	1 8	0 38	0 13	0 1	8
23	1 55	1 36	1 7	0 37	0 12	0 1	7
24	1 55	1 35	1 6	0 36	0 12	0 0	6
25	1 54	1 35	1 5	0 35	0 11	0 0	5
26	1 54	1 34	1 4	0 34	0 10	0 0	4
27	1 53	1 33	1 3	0 33	0 10	0 0	3
28	1 53	1 32	1 2	0 32	0 9	0 0	2
29	1 52	1 31	1 1	0 31	0 9	0 0	1
30	1 52	1 30	1 0	0 30	0 8	0 0	0
	VIII.	VII.	VI.	V.	IV.	III.	E
	SIGNS.						

TABLE XII.

The Sixth Equation of the Moon's Place.

ARGUMENT a.

a		a		a		a	
	′ ″		′ ″		′ ″		′ ″
0	4 0	260	4 1	500	4 0	760	4 19
10	3 33	270	4 26	510	3 36	770	5 14
20	3 7	280	4 50	520	3 13	780	5 37
30	2 42	290	5 13	530	2 51	790	6 0
40	2 18	300	5 35	540	2 30	800	6 20
50	1 55	310	5 55	550	2 10	810	6 39
60	1 34	320	6 12	560	1 52	820	6 56
70	1 16	330	6 28	570	1 36	830	7 10
80	1 0	340	6 41	580	1 23	840	7 21
90	0 46	350	6 51	590	1 12	850	7 30
100	0 36	360	6 58	600	1 4	860	7 35
110	0 28	370	7 2	610	0 59	870	7 37
120	0 24	380	7 3	620	0 57	880	7 36
130	0 23	390	7 1	630	0 58	890	7 32
140	0 25	400	6 56	640	1 2	900	7 24
150	0 30	410	6 48	650	1 9	910	7 14
160	0 39	420	6 37	660	1 19	920	7 0
170	0 50	430	6 24	670	1 32	930	6 44
180	1 4	440	6 8	680	1 48	940	6 26
190	1 21	450	5 50	690	2 5	950	6 5
200	1 40	460	5 30	700	2 25	960	5 42
210	2 0	470	5 9	710	2 47	970	5 18
220	2 23	480	4 47	720	3 10	980	4 53
230	2 46	490	4 24	730	3 34	990	4 27
240	3 11	500	4 0	740	3 59	0	4 0
250	3 36			750	4 24		

TABLE XIII.

The Seventh Equation of the Moon's Place,

ARGUMENT b.

b	′ ″	b	′ ″	b	′ ″	b	′ ″
0	4 0	260	7 17	500	4 0	760	0 43
10	4 12	270	7 15	510	3 48	770	0 44
20	4 25	280	7 14	520	3 35	780	0 46
30	4 37	290	7 11	530	3 23	790	0 49
40	4 49	300	7 7	540	3 11	800	0 53
50	5 1	310	7 3	550	2 59	810	0 57
60	5 12	320	6 58	560	2 48	820	1 2
70	5 24	330	6 53	570	2 36	830	1 7
80	5 35	340	6 46	580	2 25	840	1 14
90	5 45	350	6 39	590	2 15	850	1 21
100	5 56	360	6 32	600	2 4	860	1 28
110	6 6	370	6 24	610	1 54	870	1 36
120	6 15	380	6 15	620	1 45	880	1 45
130	6 24	390	6 6	630	1 36	890	1 54
140	6 32	400	5 56	640	1 28	900	2 4
150	6 39	410	5 45	650	1 21	910	2 15
160	6 46	420	5 35	660	1 14	920	2 25
170	6 53	430	5 24	670	1 7	930	2 36
180	6 58	440	5 12	680	1 2	940	2 48
190	7 3	450	5 1	690	0 57	950	2 59
200	7 7	460	4 49	700	0 53	960	3 11
210	7 11	470	4 37	710	0 50	970	3 23
220	7 14	480	4 25	720	0 46	980	3 35
230	7 15	490	4 12	730	0 44	990	3 48
240	7 17	500	4 0	740	0 43	0	4 0
250	7 17			750	0 43		

L

TABLE XIV.

The Eighth Equation of the Moon's Place.

ARGUMENT c.

c		c		c		c	
	′ ″		′ ″		′ ″		′ ″
0	3 0	260	0 20	500	3 0	760	5 40
10	2 50	270	0 21	510	3 10	770	5 39
20	2 40	280	0 23	520	3 20	780	5 37
30	2 30	290	0 25	530	3 30	790	5 35
40	2 20	300	0 28	540	3 40	800	5 32
50	2 11	310	0 31	550	3 49	810	5 29
60	2 1	320	0 35	560	3 59	820	5 25
70	1 52	330	0 40	570	4 8	830	5 20
80	1 43	340	0 45	580	4 17	840	5 15
90	1 34	350	0 51	590	4 26	850	5 9
100	1 26	360	0 57	600	4 34	860	5 3
110	1 18	370	1 4	610	4 42	870	4 56
120	1 11	380	1 11	620	4 49	880	4 49
130	1 4	390	1 18	630	4 56	890	4 42
140	0 57	400	1 26	640	5 3	900	4 34
150	0 51	410	1 34	650	5 9	910	4 26
160	0 45	420	1 43	660	5 15	920	4 17
170	0 40	430	1 52	670	5 20	930	4 8
180	0 35	440	2 1	680	5 25	940	3 59
190	0 31	450	2 11	690	5 29	950	3 49
200	0 28	460	2 20	700	5 32	960	3 40
210	0 25	470	2 30	710	5 35	970	3 30
220	0 23	480	2 40	720	5 37	980	3 20
230	0 21	490	2 50	730	5 39	990	3 10
240	0 20	500	3 0	740	5 40	0	3 0
250	0 20			750	5 40		

TABLE XV.

The Ninth Equation of the Moon's Place.

ARGUMENT d.

d		d		d		d	
	′ ″		′ ″		′ ″		′ ″
0	4 0	260	0 42	500	4 0	760	7 18
10	3 48	270	0 44	510	4 12	770	7 16
20	3 35	280	0 45	520	4 25	780	7 15
30	3 23	290	0 48	530	4 37	790	7 12
40	3 11	300	0 52	540	4 49	800	7 8
50	2 59	310	0 56	550	5 1	810	7 4
60	2 48	320	1 1	560	5 13	820	6 59
70	2 36	330	1 7	570	5 24	830	6 53
80	2 25	340	1 13	580	5 35	840	6 47
90	2 14	350	1 20	590	5 46	850	6 40
100	2 4	360	1 27	600	5 56	860	6 33
110	1 54	370	1 36	610	6 6	870	6 24
120	1 45	380	1 45	620	6 15	880	6 15
130	1 36	390	1 54	630	6 24	890	6 6
140	1 27	400	2 4	640	6 33	900	5 56
150	1 20	410	2 14	650	6 40	910	5 46
160	1 13	420	2 25	660	6 47	920	5 35
170	1 7	430	2 36	670	6 53	930	5 24
180	1 1	440	2 47	680	6 59	940	5 13
190	0 56	450	2 59	690	7 4	950	5 1
200	0 52	460	3 11	700	7 8	960	4 49
210	0 48	470	3 23	710	7 12	970	4 37
220	0 45	480	3 35	720	7 15	980	4 25
230	0 44	490	3 48	730	7 16	990	4 12
240	0 42	500	4 0	740	7 18	0	4 0
250	0 42			750	7 18		

TABLE XVI.

The Tenth Equation of the Moon's Place.

ARGUMENT e.

e	′	″	e	′	″	e	′	″	e	′	″
0	3	0	260	5	24	500	3	0	760	0	36
10	3	9	270	5	23	510	2	51	770	0	37
20	3	18	280	5	21	520	2	42	780	0	39
30	3	27	290	5	19	530	2	33	790	0	41
40	3	36	300	5	17	540	2	24	800	0	43
50	3	45	310	5	14	550	2	15	810	0	46
60	3	53	320	5	10	560	2	7	820	0	50
70	4	1	330	5	6	570	1	59	830	0	54
80	4	9	340	5	2	580	1	51	840	0	58
90	4	17	350	4	57	590	1	43	850	1	3
100	4	25	360	4	51	600	1	35	860	1	9
110	4	32	370	4	45	610	1	28	870	1	15
120	4	39	380	4	39	620	1	21	880	1	21
130	4	45	390	4	32	630	1	15	890	1	28
140	4	51	400	4	25	640	1	9	900	1	35
150	4	57	410	4	17	650	1	3	910	1	43
160	5	2	420	4	9	660	0	58	920	1	51
170	5	6	430	4	1	670	0	54	930	1	59
180	5	10	440	3	53	680	0	50	940	2	7
190	5	14	450	3	45	690	0	46	950	2	15
200	5	17	460	3	36	700	0	43	960	2	24
210	5	19	470	3	27	710	0	41	970	2	33
220	5	21	480	3	18	720	0	39	980	2	42
230	5	23	490	3	9	730	0	37	990	2	51
240	5	24	500	3	0	740	0	36	0	3	0
250	5	24				750	0	36			

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TABLE XVII.

The Eleventh Equation of the Moon's Place.

ARGUMENT f.

f	′ ″	f	′ ″	f	′ ″	f	′ ″
0	3 0	260	1 12	500	3 0	760	4 48
10	2 53	270	1 13	510	3 7	770	4 47
20	2 46	280	1 14	520	3 14	780	4 46
30	2 40	290	1 15	530	3 20	790	4 45
40	2 33	300	1 17	540	3 27	800	4 43
50	2 27	310	1 20	550	3 33	810	4 40
60	2 20	320	1 22	560	3 40	820	4 38
70	2 14	330	1 25	570	3 46	830	4 35
80	2 8	340	1 29	580	3 52	840	4 31
90	2 2	350	1 33	590	3 58	850	4 27
100	1 57	360	1 37	600	4 3	860	4 23
110	1 51	370	1 41	610	4 9	870	4 19
120	1 46	380	1 46	620	4 14	880	4 14
130	1 41	390	1 51	630	4 19	890	4 9
140	1 37	400	1 57	640	4 23	900	4 3
150	1 33	410	2 2	650	4 27	910	3 58
160	1 29	420	2 8	660	4 31	920	3 52
170	1 25	430	2 14	670	4 35	930	3 46
180	1 22	440	2 20	680	4 38	940	3 39
190	1 20	450	2 27	690	4 40	950	3 33
200	1 17	460	2 33	700	4 43	960	3 27
210	1 15	470	2 40	710	4 45	970	3 20
220	1 14	480	2 46	720	4 46	980	3 14
230	1 13	490	2 53	730	4 47	990	3 7
240	1 12	500	3 0	740	4 48	0	3 0
250	1 12			750	4 48		

TABLE XVIII.

The Twelfth Equation of the Moon's Place.

ARGUMENT g.

g	′	″	g	′	″	g	′	″	g	′	″
0	3	0	260	1	52	500	3	0	760	4	8
10	2	56	270	1	53	510	3	4	770	4	7
20	2	51	280	1	53	520	3	9	780	4	7
30	2	47	290	1	54	530	3	13	790	4	6
40	2	43	300	1	55	540	3	17	800	4	5
50	2	39	310	1	57	550	3	21	810	4	3
60	2	35	320	1	58	560	3	25	820	4	2
70	2	31	330	2	0	570	3	29	830	4	0
80	2	27	340	2	3	580	3	33	840	3	57
90	2	24	350	2	5	590	3	36	850	3	55
100	2	20	360	2	8	600	3	40	860	3	52
110	2	17	370	2	11	610	3	43	870	3	49
120	2	13	380	2	13	620	3	47	880	3	47
130	2	11	390	2	17	630	3	49	890	3	43
140	2	8	400	2	20	640	3	52	900	3	40
150	2	5	410	2	24	650	3	55	910	3	36
160	2	3	420	2	27	660	3	57	920	3	33
170	2	0	430	2	31	670	4	0	930	3	29
180	1	58	440	2	35	680	4	2	940	3	25
190	1	57	450	2	39	690	4	3	950	3	21
200	1	55	460	2	43	700	4	5	960	3	17
210	1	54	470	2	47	710	4	6	970	3	13
220	1	53	480	2	51	720	4	7	980	3	9
230	1	53	490	2	56	730	4	7	990	3	4
240	1	52	500	3	0	740	4	8	0	3	0
250	1	52				750	4	8			

TABLE XIX.

TABLE XIX.

The Thirteenth Equation of the Moon's Place.

ARGUMENT h.

h	′ ″	h	′ ″	h	′ ″	h	′ ″
0	3 0	260	4 28	500	3 0	760	1 32
10	3 6	270	4 27	510	2 54	770	1 33
20	3 11	280	4 26	520	2 49	780	1 34
30	3 16	290	4 25	530	2 44	790	1 35
40	3 22	300	4 24	540	2 38	800	1 36
50	3 27	310	4 22	550	2 33	810	1 38
60	3 32	320	4 20	560	2 28	820	1 40
70	3 37	330	4 17	570	2 23	830	1 43
80	3 42	340	4 14	580	2 18	840	1 46
90	3 47	350	4 11	590	2 13	850	1 49
100	3 52	360	4 8	600	2 8	860	1 52
110	3 56	370	4 4	610	2 4	870	1 56
120	4 0	380	4 0	620	2 0	880	2 0
130	4 4	390	3 56	630	1 56	890	2 4
140	4 8	400	3 52	640	1 52	900	2 8
150	4 11	410	3 47	650	1 49	910	2 13
160	4 14	420	3 42	660	1 46	920	2 18
170	4 17	430	3 37	670	1 43	930	2 23
180	4 20	440	3 32	680	1 40	940	2 28
190	4 22	450	3 27	690	1 38	950	2 33
200	4 24	460	3 22	700	1 36	960	2 38
210	4 25	470	3 16	710	1 35	970	2 44
220	4 26	480	3 11	720	1 34	980	2 49
230	4 27	490	3 6	730	1 33	990	2 54
240	4 28	500	3 0	740	1 32	0	3 0
250	4 28			750	1 32		

TABLE XX.

The Fourteenth Equation of the Moon's Place.

ARGUMENT i.

i		i		i		i	
	′		′		′		′
0	30	260	34	500	30	760	22
10	33	270	32	510	32	770	20
20	35	280	29	520	34	780	18
30	38	290	27	530	35	790	16
40	40	300	25	540	37	800	14
50	42	310	23	550	39	810	12
60	44	320	22	560	40	820	11
70	46	330	20	570	41	830	10
80	48	340	19	580	42	840	9
90	50	350	18	590	43	850	8
100	51	360	17	600	44	860	8
110	51	370	16	610	44	870	8
120	52	380	16	620	44	880	8
130	52	390	16	630	44	890	8
140	52	400	16	640	43	900	9
150	52	410	17	650	42	910	10
160	51	420	18	660	41	920	12
170	50	430	19	670	40	930	14
180	49	440	20	680	38	940	16
190	48	450	21	690	37	950	18
200	46	460	23	700	35	960	20
210	44	470	25	710	33	670	22
220	42	480	26	720	31	980	25
230	40	490	28	730	29	990	27
240	38	500	30	740	26	0	30
250	36			750	24		

TABLE XXI.

The Fifteenth Equation of the Moon's Place,

ARGUMENT k.

k		k		k		k	
	″		″		″		″
0	30	260	3	500	30	760	57
10	28	270	3	510	32	770	57
20	27	280	3	520	33	780	57
30	25	290	4	530	35	790	56
40	23	300	4	540	37	800	56
50	22	310	5	550	38	810	55
60	20	320	6	560	40	820	54
70	18	330	6	570	42	830	54
80	17	340	7	580	43	840	53
90	16	350	8	590	45	850	52
100	14	360	9	600	46	860	51
110	13	370	10	610	47	870	50
120	12	380	12	620	48	880	48
130	10	390	13	630	50	890	47
140	9	400	14	640	51	900	46
150	8	410	15	650	52	910	45
160	7	420	17	660	53	920	43
170	6	430	18	670	54	930	42
180	6	440	20	680	54	940	40
190	5	450	22	690	55	950	38
200	4	460	23	700	56	960	37
210	4	470	25	710	56	970	35
220	3	480	27	720	57	980	33
230	3	490	28	730	57	990	32
240	3	500	30	740	57	0	30
250	3			750	57		

TABLE XXII.

The Sixteenth Equation of the Moon's Place.

ARGUMENT I.

I	″	I	″	I	″	I	″
0	30	260	53	500	30	760	7
10	31	270	53	510	29	770	7
20	33	280	53	520	27	780	7
30	34	290	52	530	26	790	8
40	36	300	52	540	24	800	8
50	37	310	51	550	23	810	9
60	38	320	51	560	22	820	9
70	40	330	50	570	20	830	10
80	41	340	49	580	19	840	11
90	42	350	49	590	18	850	11
100	43	360	48	600	17	860	12
110	45	370	47	610	15	870	13
120	46	380	46	620	14	880	14
130	47	390	45	630	13	890	15
140	48	400	43	640	12	900	17
150	49	410	42	650	11	910	18
160	49	420	41	660	11	920	19
170	50	430	40	670	10	930	20
180	51	440	38	680	9	940	22
190	51	450	37	690	9	950	23
200	52	460	36	700	8	960	24
210	52	470	34	710	8	970	26
220	53	480	33	720	7	980	27
230	53	490	31	730	7	990	29
240	53	500	30	740	7	0	30
250	53			750	7		

TABLE XXIII.

TABLE XXIII.

The Seventeenth Equation of the Moon's Place.

ARGUMENT m.

m	″	m	″	m	″	m	″
0	30	260	50	500	30	760	10
10	31	270	50	510	29	770	10
20	32	280	50	520	28	780	10
30	34	290	49	530	26	790	11
40	35	300	49	540	25	800	11
50	36	310	49	550	24	810	11
60	37	320	48	560	23	820	12
70	38	330	48	570	22	830	12
80	40	340	47	580	20	840	13
90	41	350	46	590	19	850	14
100	42	360	45	600	18	860	15
110	43	370	45	610	17	870	15
120	44	380	44	620	16	880	16
130	45	390	43	630	15	890	17
140	45	400	42	640	15	900	18
150	46	410	41	650	14	910	19
160	47	420	40	660	13	920	20
170	48	430	38	670	12	930	22
180	48	440	37	680	12	940	23
190	49	450	36	690	11	950	24
200	49	460	35	700	11	960	25
210	49	470	34	710	11	970	26
220	50	480	32	720	10	980	28
230	50	490	31	730	10	990	29
240	50	500	30	740	10	0	30
250	50			750	10		

TABLE XXIV.

The Eighteenth Equation of the Moon's Place.

ARGUMENT n.

n	″	n	″	n	″	n	″
0	20	260	32	500	20	760	8
10	21	270	32	510	19	770	8
20	22	280	32	520	19	780	8
30	22	290	32	530	18	790	8
40	23	300	31	540	17	800	9
50	24	310	31	550	16	810	9
60	24	320	31	560	16	820	9
70	25	330	31	570	15	830	9
80	26	340	30	580	14	840	10
90	26	350	30	590	14	850	10
100	27	360	29	600	13	860	11
110	28	370	29	610	12	870	11
120	28	380	28	620	12	880	12
130	29	390	28	630	11	890	12
140	29	400	27	640	11	900	13
150	30	410	26	650	10	910	14
160	30	420	26	660	10	920	14
170	31	430	25	670	9	930	15
180	31	440	24	680	9	940	16
190	31	450	24	690	9	950	16
200	31	460	23	700	9	960	17
210	32	470	22	710	8	970	18
220	32	480	22	720	8	980	18
230	32	490	21	730	8	990	19
240	32	500	20	740	8	0	20
250	32			750	8		

TABLE XXV

TABLE XXV.

The Nineteenth Equation of the Moon's Place.

ARGUMENT o.

°	″	°	″	°	″	°	″
0	20	260	9	500	20	760	31
10	19	270	9	510	21	770	31
20	19	280	9	520	21	780	31
30	18	290	9	530	22	790	31
40	17	300	10	540	23	800	30
50	17	310	10	550	23	810	30
60	16	320	10	560	24	820	30
70	15	330	10	570	25	830	30
80	15	340	11	580	25	840	29
90	14	350	11	590	26	850	29
100	13	360	12	600	26	860	28
110	13	370	12	610	27	870	28
120	12	380	13	620	27	880	27
130	12	390	13	630	28	890	27
140	11	400	14	640	28	900	26
150	11	410	14	650	29	910	26
160	10	420	15	660	29	920	25
170	10	430	15	670	30	930	25
180	10	440	16	680	30	940	24
190	10	450	17	690	30	950	23
200	10	460	17	700	30	960	23
210	9	470	18	710	31	970	22
220	9	480	19	720	31	980	21
230	9	490	19	730	31	990	21
240	9	500	20	740	31	0	20
250	9			750	31		

TABLE XXVI.

The Twentieth Equation of the Moon's Place.

ARGUMENT p.

p		p		p		p	
	″		″		″		″
0	20	260	38	500	20	760	2
10	21	270	38	510	19	770	2
20	22	280	38	520	18	780	2
30	23	290	37	530	17	790	3
40	24	300	37	540	16	800	3
50	26	310	37	550	14	810	3
60	27	320	36	560	13	820	4
70	28	330	36	570	12	830	4
80	29	340	35	580	11	840	5
90	30	350	35	590	10	850	5
100	31	360	34	600	9	860	6
110	31	370	33	610	9	870	7
120	32	380	32	620	8	880	8
130	33	390	31	630	7	890	9
140	34	400	31	640	6	900	9
150	35	410	30	650	5	910	10
160	35	420	29	660	5	920	11
170	36	430	28	670	4	930	12
180	36	440	27	680	4	940	13
190	37	450	26	690	3	950	14
200	37	460	24	700	3	960	16
210	37	470	23	710	3	970	17
220	38	480	22	720	2	980	18
230	38	490	21	730	2	990	19
240	38	500	20	740	2	0	20
250	38			750	2		

TABLE XXVII.

The Firſt Equation of the Supplement of the Node.

A	ARGUMENT A. IX.	X.	XI.	O.	I.	II.	
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
0	0 57	1 14	1 58	3 0	4 2	4 46	30
1	0 57	1 15	2 0	3 2	4 4	4 47	29
2	0 57	1 16	2 2	3 4	4 6	4 48	28
3	0 57	1 17	2 4	3 6	4 8	4 49	27
4	0 57	1 18	2 6	3 8	4 9	4 50	26
5	0 57	1 19	2 8	3 11	4 11	4 51	25
6	0 58	1 20	2 10	3 13	4 13	4 52	24
7	0 58	1 22	2 12	3 15	4 15	4 53	23
8	0 58	1 23	2 14	3 17	4 17	4 34	22
9	0 58	1 25	2 16	3 19	4 19	4 55	21
10	0 59	1 26	2 18	3 21	4 21	4 55	20
11	0 59	1 27	2 21	3 23	4 23	4 56	19
12	1 0	1 29	2 23	3 25	4 24	4 56	18
13	1 1	1 30	2 25	3 27	4 25	4 57	17
14	1 2	1 31	2 27	3 29	4 26	4 58	16
15	1 2	1 33	2 29	3 31	4 27	4 58	15
16	1 2	1 34	2 31	3 33	4 29	4 59	14
17	1 3	1 35	2 33	3 35	4 30	5 0	13
18	1 4	1 36	2 35	3 37	4 31	5 1	12
19	1 4	1 37	2 37	3 39	4 33	5 1	11
20	1 5	1 39	2 39	3 42	4 34	5 1	10
21	1 5	1 41	2 41	3 44	4 35	5 2	9
22	1 6	1 43	2 43	3 46	4 37	5 2	8
23	1 7	1 45	2 45	3 48	4 38	5 2	7
24	1 8	1 47	2 47	3 50	4 40	5 2	6
25	1 9	1 49	2 49	3 52	4 41	5 3	5
26	1 10	1 51	2 52	3 54	4 42	5 3	4
27	1 11	1 52	2 54	3 56	4 43	5 3	3
28	1 12	1 54	2 56	3 58	4 44	5 3	2
29	1 13	1 56	2 58	4 0	4 45	5 3	1
30	1 14	1 58	3 0	4 2	4 46	5 3	0
	VIII.	VII.	VI.	V.	IV.	III.	A

TABLE XXVIII.

The Second Equation of the Supplement of the Node.

ARGUMENT D.

D	IX.		X.		XI.		O.		I.		II.		
	′	″	′	″	′	″	′	″	′	″	′	″	
0	27	23	25	59	22	12	17	0	11	48	8	1	30
1	27	23	25	54	22	2	16	49	11	39	7	56	29
2	27	23	25	48	21	52	16	38	11	30	7	50	28
3	27	22	25	42	21	43	16	27	11	21	7	45	27
4	27	21	25	36	21	33	16	17	11	12	7	41	26
5	27	20	25	30	21	23	16	6	11	3	7	36	25
6	27	19	25	24	21	13	15	55	10	54	7	32	24
7	27	17	25	17	21	3	15	44	10	45	7	27	23
8	27	16	25	10	20	53	15	34	10	37	7	23	22
9	27	15	25	4	20	43	15	23	10	28	7	19	21
10	27	13	24	57	20	33	15	12	10	20	7	15	20
11	27	11	24	50	20	23	15	1	10	11	7	12	19
12	27	9	24	43	20	12	14	50	10	4	7	8	18
13	27	6	24	35	20	2	14	40	9	56	7	5	17
14	27	4	24	28	19	52	14	30	9	48	7	2	16
15	27	1	24	20	19	41	14	19	9	40	6	59	15
16	26	58	24	12	19	30	14	8	9	32	6	56	14
17	26	55	24	4	19	20	13	58	9	25	6	54	13
18	26	52	23	56	19	10	13	48	9	17	6	51	12
19	26	48	23	49	18	59	13	37	9	10	6	49	11
20	26	45	23	40	18	48	13	27	9	3	6	47	10
21	26	41	23	32	18	37	13	16	8	56	6	45	9
22	26	37	23	23	18	26	13	7	8	50	6	44	8
23	26	33	23	15	18	16	12	57	8	43	6	43	7
24	26	28	23	6	18	5	12	47	8	36	6	41	6
25	26	24	22	57	17	54	12	37	8	30	6	40	5
26	26	19	22	48	17	43	12	27	8	24	6	39	4
27	26	15	22	39	17	33	12	17	8	18	6	38	3
28	26	10	22	30	17	22	12	8	8	12	6	37	2
29	26	4	22	21	17	11	11	58	8	6	6	37	1
30	25	59	22	12	17	0	11	48	8	1	6	37	0
	VIII.		VII.		VI.		V.		IV.		III.		D.

TABLE XXIX.

TABLE XXIX.

Reduction to the ECLIPTIC.

ARGUMENT L.

L	VI.		VII.		VIII.		IX.		X.		XI.	
	O.		I.		II.		III.		IV.		V.	
	′	″	′	″	′	″	′	″	′	″	′	″
0	9	0	2	58	2	58	9	0	15	2	15	2
1	8	46	2	51	3	5	9	14	15	9	14	55
2	8	31	2	45	3	13	9	29	15	15	14	47
3	8	17	2	39	3	21	9	43	15	21	14	39
4	8	2	2	33	3	30	9	58	15	27	14	30
5	7	48	2	28	3	40	10	12	15	32	14	20
6	7	34	2	23	3	50	10	26	15	37	14	10
7	7	19	2	19	4	0	10	41	15	41	14	0
8	7	5	2	15	4	10	10	55	15	45	13	50
9	6	51	2	12	4	21	11	9	15	48	13	39
10	6	37	2	9	4	32	11	23	15	51	13	28
11	6	23	2	6	4	43	11	37	15	54	13	17
12	6	10	2	4	4	55	11	50	15	56	13	5
13	5	57	2	3	5	7	12	3	15	57	12	53
14	5	44	2	3	5	19	12	16	15	57	12	41
15	5	31	2	3	5	31	12	29	15	57	12	29
16	5	19	2	3	5	44	12	41	15	57	12	16
17	5	7	2	3	5	57	12	53	15	57	12	3
18	4	55	2	4	6	10	13	5	15	56	11	50
19	4	43	2	6	6	23	13	17	15	54	11	37
20	4	32	2	9	6	37	13	28	15	51	11	23
21	4	21	2	12	6	51	13	39	15	48	11	9
22	4	10	2	15	7	5	13	50	15	45	10	55
23	4	0	2	19	7	19	14	0	15	41	10	41
24	3	50	2	23	7	34	14	10	15	37	10	26
25	3	40	2	28	7	48	14	20	15	32	10	12
26	3	30	2	33	8	2	14	30	15	27	9	58
27	3	21	2	39	8	17	14	39	15	21	9	43
28	3	13	2	45	8	31	14	47	15	15	9	29
29	3	5	2	51	8	46	14	55	15	9	9	14
30	2	58	2	58	9	0	15	2	15	2	9	0

TABLE XXX.

Equation of the Equinoctial Point of ARIES.

ARGUMENT N.

N	IX.	X.	XI.	O.	I.	II.	
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
0	0 43	0 46	0 52	1 0	1 8	1 14	30
1	0 43	0 46	0 52	1 0	1 8	1 14	29
2	0 43	0 46	0 52	1 1	1 9	1 15	28
3	0 43	0 46	0 53	1 1	1 9	1 15	27
4	0 43	0 46	0 53	1 1	1 9	1 15	26
5	0 44	0 46	0 53	1 1	1 9	1 15	25
6	0 44	0 47	0 53	1 2	1 10	1 15	24
7	0 44	0 47	0 54	1 2	1 10	1 15	23
8	0 44	0 47	0 54	1 2	1 10	1 15	22
9	0 44	0 47	0 54	1 2	1 10	1 15	21
10	0 44	0 47	0 55	1 3	1 11	1 16	20
11	0 44	0 48	0 55	1 3	1 11	1 16	19
12	0 44	0 48	0 55	1 3	1 11	1 16	18
13	0 44	0 48	0 55	1 4	1 11	1 16	17
14	0 44	0 48	0 56	1 4	1 11	1 16	16
15	0 44	0 48	0 56	1 4	1 12	1 16	15
16	0 44	0 49	0 56	1 4	1 12	1 16	14
17	0 44	0 49	0 56	1 5	1 12	1 16	13
18	0 44	0 49	0 57	1 5	1 12	1 16	12
19	0 44	0 49	0 57	1 5	1 12	1 16	11
20	0 44	0 49	0 57	1 5	1 13	1 16	10
21	0 45	0 50	0 58	1 6	1 13	1 16	9
22	0 45	0 50	0 58	1 6	1 13	1 16	8
23	0 45	0 50	0 58	1 6	1 13	1 16	7
24	0 45	0 50	0 58	1 7	1 13	1 16	6
25	0 45	0 51	0 59	1 7	1 14	1 16	5
26	0 45	0 51	0 59	1 7	1 14	1 17	4
27	0 45	0 51	0 59	1 7	1 14	1 17	3
28	0 45	0 51	0 59	1 8	1 14	1 17	2
29	0 46	0 52	1 0	1 8	1 14	1 17	1
30	0 46	0 52	1 0	1 8	1 14	1 17	0
	VIII.	VII.	VI.	V.	IV.	III.	N

TABLE XXXI.

The Moon's Diſtance from the North Pole of the Ecliptic.

ARGUMENT L.

L.	O.	diff.	I.	diff.	II.	diff.	
—	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ′	—
0	89 49 38	5 23	87 15 28	4 38	85 22 26	2 40	30
1	89 44 15	5 23	87 10 50	4 35	85 19 46	2 35	29
2	89 38 52	5 22	87 6 15	4 32	85 17 11	2 29	28
3	89 33 30	5 22	87 1 43	4 30	85 14 42	2 24	27
4	89 28 8	5 21	86 57 13	4 27	85 12 18	2 20	26
5	89 22 47		86 52 46		85 9 58		25
—		5 21		4 24		2 14	—
6	89 17 26	5 21	86 48 22	4 20	85 7 44	2 9	24
7	89 12 5	5 20	86 44 2	4 16	85 5 35	2 3	23
8	89 6 45	5 20	86 39 46	4 12	85 3 32	1 59	22
9	89 1 25	5 19	86 35 34	4 9	85 1 33	1 54	21
10	88 56 6		86 31 25		84 59 39		20
—		5 1		4 6		1 48	—
11	88 50 48	5 16	86 27 19	4 3	84 57 51	1 43	19
12	88 45 32	5 15	86 23 16	3 59	84 56 8	1 38	18
13	88 40 17	5 14	86 19 17	3 54	84 54 30	1 32	17
14	88 35 3	5 12	86 15 23	3 51	84 52 58	1 26	16
15	88 29 51		86 11 32		84 51 32		15
—		5 11		3 47		1 21	—
16	88 24 40	5 9	86 7 45	3 43	84 50 11	1 15	14
17	88 19 31	5 8	86 4 2	3 38	84 48 56	1 10	13
18	88 14 23	5 6	86 0 24	3 34	84 47 46	1 5	12
19	88 9 17	5 5	85 56 50	3 30	84 46 41	0 59	11
20	88 4 12		85 53 20		84 45 42		10
—		5 3		3 26		0 54	—
21	87 59 9	5 0	85 49 54	3 22	84 44 48	0 48	9
22	87 54 9	4 58	85 46 32	3 18	84 44 0	0 43	8
23	87 49 11	4 56	85 43 14	3 12	84 43 17	0 36	7
24	87 44 15	4 54	85 40 2	3 8	84 42 41	0 31	6
25	87 39 21		85 36 54		84 42 10		5
—		4 52		3 3		0 26	—
26	87 34 29	4 49	85 33 51	2 58	84 41 44	0 20	4
27	87 29 40	4 46	85 30 53	2 53	84 41 24	0 14	3
28	87 24 54	4 44	85 28 0	2 49	84 41 10	0 8	2
29	87 20 10	4 42	85 25 11	2 45	84 41 2	0 2	1
30	87 15 28		85 22 26		84 41 0		0
—	V.		IV.		III.		—

TABLE XXXI.

The Moon's Diſtance from the North Pole of the Ecliptic.

ARGUMENT L.

L.	IX.	diff.	X.	diff.	XI.	diff.	—
—	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	
0	94 58 16	0 2	94 16 50	2 45	92 23 48	4 42	30
1	94 58 14	0 8	94 14 5	2 49	92 19 6	4 44	29
2	94 58 6	0 14	94 11 16	2 53	92 14 22	4 46	28
3	94 57 52	0 20	94 8 23	2 58	92 9 36	4 49	27
4	94 57 32	0 26	94 5 25	3 3	92 4 47	4 52	26
5	94 57 6		94 2 22		91 59 55		25
—		0 31		3 8		4 54	—
6	94 56 35	0 36	93 59 14	3 12	91 55 1	4 56	24
7	94 55 59	0 43	93 56 2	3 18	91 50 5	4 58	23
8	94 55 16	0 48	93 52 44	3 22	91 45 7	5 0	22
9	94 54 28	0 54	93 49 22	3 26	91 40 7	5 3	21
10	94 53 34		93 45 56		91 35 4		20
—		0 59		3 30		5 5	—
11	94 52 35	1 5	93 42 26	3 34	91 29 59	5 6	19
12	94 51 30	1 10	93 38 52	3 38	91 24 53	5 8	18
13	94 50 20	1 15	93 35 14	3 43	91 19 45	5 9	17
14	94 49 5	1 21	93 31 31	3 47	91 14 36	5 11	16
15	94 47 44		93 27 44		91 9 25		15
—		1 26		3 51		5 12	—
16	94 46 18	1 32	93 23 53	3 54	91 4 13	5 14	14
17	94 44 46	1 38	93 19 59	3 59	90 58 59	5 15	13
18	94 43 8	1 43	93 16 0	4 3	90 53 44	5 16	12
19	94 41 25	1 48	93 11 57	4 6	90 48 28	5 18	11
20	94 39 37		93 7 51		90 43 10		10
—		1 54		4 9		5 19	—
21	94 37 43	1 59	93 3 42	4 12	90 37 51	5 20	9
22	94 35 44	2 3	92 59 30	4 16	90 32 31	5 20	8
23	94 33 41	2 9	92 55 14	4 20	90 27 11	5 21	7
24	94 31 32	2 14	92 50 54	4 24	90 21 50	5 21	6
25	94 29 18		92 46 30		90 16 29		5
—		2 20		4 27		5 21	—
26	94 26 58	2 24	92 42 3	4 30	90 11 8	5 22	4
27	94 24 34	2 29	92 37 33	4 32	90 5 46	5 22	3
28	94 22 5	2 35	92 33 1	4 35	90 0 24	5 23	2
29	94 19 30	2 40	92 28 26	4 38	89 55 1	5 23	1
30	94 16 50		92 23 48		89 49 38		0
—							—
	VIII.		VII.		VI.		

TABLE XXXII

TABLE XXXII.

The First Equation of the Moon's Diſtance from the North Pole of the Ecliptic,

ARGUMENT L—E.

L–E	Sig. IX.	X.	XI.	O.	I.	II.	
0	17′ 28″	16′ 18″	13′ 6″	8′ 44″	4′ 22″	1′ 10″	30
1	17 28	16 13	12 58	8 35	4 14	1 6	29
2	17 27	16 8	12 50	8 25	4 6	1 1	28
3	17 27	16 3	12 42	8 16	3 58	0 57	27
4	17 26	15 58	12 34	8 7	3 50	0 53	26
5	17 26	15 53	12 25	7 58	3 43	0 49	25
6	17 25	15 48	12 17	7 49	3 35	0 45	24
7	17 24	15 43	12 9	7 40	3 28	0 42	23
8	17 23	15 38	12 0	7 31	3 21	0 38	22
9	17 21	15 33	11 52	7 22	3 14	0 35	21
10	17 20	15 27	11 43	7 13	3 7	0 32	20
11	17 18	15 21	11 35	7 4	3 0	0 29	19
12	17 16	15 14	11 26	6 55	2 54	0 26	18
13	17 14	15 8	11 17	6 46	2 47	0 23	17
14	17 12	15 1	11 8	6 37	2 40	0 20	16
15	17 10	14 54	11 0	6 28	2 34	0 18	15
16	17 8	14 48	10 51	6 20	2 27	0 16	14
17	17 5	14 41	10 42	6 11	2 20	0 14	13
18	17 2	14 34	10 33	6 2	2 14	0 12	12
19	16 59	14 28	10 24	5 53	2 7	0 10	11
20	16 56	14 21	10 15	5 45	2 1	0 8	10
21	16 53	14 14	10 6	5 36	1 55	0 7	9
22	16 50	14 7	9 57	5 28	1 50	0 5	8
23	16 46	14 0	9 48	5 19	1 45	0 4	7
24	16 43	13 53	9 39	5 11	1 40	0 3	6
25	16 39	13 45	9 30	5 3	1 35	0 2	5
26	16 35	13 38	9 21	4 54	1 30	0 2	4
27	16 31	13 30	9 12	4 46	1 25	0 1	3
28	16 27	13 22	9 3	4 38	1 20	0 1	2
29	16 22	13 14	8 53	4 30	1 15	0 0	1
30	16 18	13 6	8 44	4 22	1 10	0 0	0
	Sig. VIII.	VII.	VI.	V.	IV.	III.	L–E

TABLE XXXIII.

TABLE XXXIII. The Second Equation of the Moon's Diſtance from the North Pole of the Ecliptic.

ARGUMENT A.

ARGUMENT L.	0 ſ.			I ſ.			II ſ.		
	0°	10°	20°	0°	10°	20°	0°	10°	20
0 ſ. 0°	34″	27″	20″	14″	11″	9″	10″	13″	18″
0	39	32	25	19	14	11	10	12	15
10	45	38	31	24	18	13	11	11	13
I. 0	50	44	36	29	22	16	12	11	12
10	55	49	42	34	26	20	14	12	11
20	59	54	47	39	31	24	17	13	11
I. 0	1 3	58	52	44	36	28	21	15	12
10	1 6	1 1	56	49	41	33	24	18	13
2	1 7	1 4	1 0	53	45	37	29	21	14
III. 0	1 7	1 6	1 2	57	50	41	32	24	17
10	1 7	1 7	1 4	1 0	54	45	37	28	20
20	1 6	1 6	1 5	1 2	57	49	41	32	23
V. 0	1 3	1 5	1 5	1 3	59	53	45	36	27
10	59	1 3	1 5	1 4	1 1	56	48	40	31
20	55	1 0	1 3	1 3	1 2	58	51	43	35
V. 0	50	56	1 0	1 2	1 2	59	54	47	39
10	45	51	56	1 0	1 1	59	56	50	43
20	39	46	52	57	59	59	57	53	46
VI. 0	34	41	47	53	57	58	58	55	49
10	28	35	42	50	54	57	57	56	52
20	22	29	37	44	50	54	56	57	54
VII. 0	17	23	32	39	45	51	55	57	55
10	12	18	26	33	41	48	53	56	57
20	8	13	20	28	36	43	50	55	57
VIII. 0	5	10	16	24	32	39	47	53	56
10	2	6	11	18	27	35	43	50	55
20	1	3	8	14	22	31	39	47	53
IX. 0	0	1	5	10	17	26	35	43	50
10	1	1	3	7	14	22	31	40	47
20	2	1	3	6	10	18	29	36	44
X. 0	5	2	2	4	8	15	23	32	40
10	8	4	3	4	7	12	19	28	37
20	12	7	5	4	6	10	16	24	33
XI. 0	17	12	7	5	6	9	13	20	29
10	22	16	11	7	6	8	12	17	25
20	28	21	15	11	8	8	10	15	21
30	34	27	20	14	11	9	10	13	18

Continuation of TABLE XXXIII.

ARGUMENT A.

ARGUMENT L.	III s.			IV s.			V s.			
	0°	10°	20°	0°	10°	20°	0°	10°	20°	30°
	25″	33″	40	47″	52″	54″	52″	48″	41″	34″
	21	29	36	44	49	52	52	48	43	35
	18	25	32	40	46	49	51	49	44	37
	15	21	28	35	42	47	49	48	45	39
	13	18	24	31	38	44	47	48	45	40
	12	15	20	27	34	40	45	46	45	41
	11	12	17	23	30	36	42	45	45	42
	10	11	14	20	26	32	39	43	45	43
	11	10	12	16	22	29	35	41	44	44
	12	9	10	13	18	25	32	38	42	44
	14	10	9	11	16	22	29	36	41	44
	16	11	9	10	13	19	26	33	39	43
	19	13	10	9	11	17	23	31	37	43
	23	16	11	9	10	15	21	28	35	41
	26	19	13	10	10	13	19	26	33	40
	30	22	16	11	10	12	17	24	31	39
	34	26	19	14	11	12	16	22	29	37
	38	30	22	16	13	13	15	20	28	35
	42	34	27	20	15	14	15	20	26	34
	46	38	31	24	18	15	16	19	25	32
	49	43	35	28	22	18	17	18	24	30
	52	47	39	32	26	21	18	19	23	28
	54	50	43	36	30	24	20	20	22	27
	56	53	47	40	34	28	23	21	22	26
	57	55	51	45	38	31	26	22	22	25
	57	56	54	49	41	35	29	24	22	25
	57	58	56	52	45	38	32	26	24	24
	56	58	57	54	49	42	35	29	25	23
	54	57	58	56	52	45	38	32	26	24
	51	56	59	57	55	49	41	34	28	25
	49	54	58	58	56	51	44	37	30	25
	45	52	57	58	57	53	47	39	32	26
	41	49	55	57	58	54	49	42	34	27
	37	45	52	56	57	55	51	44	36	28
	33	41	49	54	56	56	52	46	38	30
	29	37	45	51	54	55	52	47	40	32
	25	33	40	47	52	54	52	48	41	34

Continuation of TABLE XXXIII.

ARGUMENT A.

Argument L.		VI ſ.			VII ſ.			VIII ſ.		
		0°	10°	20°	0°	10°	20°	0°	10°	20°
O ſ.	0°	34″	26″	20″	15″	14″	15	20	27″	34″
	10	35	28	20	15	13	13	16	22	30
	20	37	29	22	16	12	11	14	19	26
I	0	39	31	24	17	12	10	11	16	22
	10	40	33	26	18	13	10	10	13	19
	20	41	35	28	21	14	10	9	11	16
II	0	43	37	31	23	17	11	9	10	13
	10	43	39	33	26	19	13	10	9	11
	20	44	41	36	29	22	16	11	9	10
III	0	44	42	38	32	25	18	13	10	9
	10	44	44	41	35	29	22	16	12	10
	20	43	45	44	38	32	26	20	14	11
IV	0	43	45	45	41	36	30	23	17	12
	10	41	45	46	44	40	34	27	20	15
	20	40	45	48	47	44	38	31	24	18
V.	0	39	45	48	49	47	42	35	28	21
	10	37	44	49	51	49	46	40	32	25
	20	35	43	48	52	52	49	44	37	29
VI.	0	34	41	48	52	54	51	47	40	33
	10	32	40	47	52	55	54	51	45	37
	20	30	38	46	52	56	56	54	49	41
VII.	0	28	36	44	51	55	57	56	52	45
	10	27	34	42	49	54	58	57	55	49
	20	26	32	39	47	53	57	58	57	52
VIII.	0	25	30	37	44	51	56	59	58	54
	10	25	28	34	41	49	55	57	59	56
	20	24	26	32	38	45	52	56	59	57
IX.	0	23	25	29	35	42	49	54	57	58
	10	24	24	26	32	38	45	52	56	58
	20	25	22	24	29	35	41	48	54	56
X.	0	25	22	22	26	31	38	45	51	55
	10	26	22	21	23	28	33	40	48	53
	20	27	22	20	20	24	30	36	43	50
XI.	0	28	23	18	19	21	26	32	39	47
	10	30	23	18	17	18	22	28	35	43
	20	32	25	19	16	15	18	24	31	38
	30	34	26	20	15	14	15	20	27	34

Continuation of TABLE XXXIII.

ARGUMENT A.

ARGUMENT L.

IX ſ.			X ſ.			XI ſ.			
0°	10°	20°	0°	10°	20°	0°	10°	20°	30°
42″	48″	55″	58″	58″	0′ 57″	0′ 53″	0′ 47″	0′ 41″	0′ 34″
38	46	53	57	59	0 59	0 57	0 52	0 46	0 39
34	43	50	56	59	1 1	1 0	0 56	0 51	0 45
30	39	47	54	59	1 2	1 2	1 0	0 56	0 50
26	35	43	51	58	1 2	1 3	1 2	1 0	0 55
22	31	40	48	55	1 1	1 4	1 4	1 3	0 59
19	27	36	45	53	0 59	1 3	1 5	1 5	1 3
16	23	32	41	49	0 57	1 2	1 5	1 6	1 6
14	20	28	37	45	0 53	1 0	1 4	1 7	1 7
12	17	24	32	41	0 50	0 57	1 2	1 6	1 7
11	15	21	29	37	0 45	0 53	1 0	1 4	1 7
10	13	18	24	33	0 41	0 49	0 56	1 1	1 6
11	12	15	21	28	0 36	0 44	0 52	0 58	1 3
12	11	13	17	24	0 31	0 39	0 47	0 54	0 59
13	11	12	14	20	0 26	0 34	0 42	0 49	0 55
15	12	11	12	16	0 22	0 29	0 36	0 44	0 50
18	13	11	11	13	0 18	0 24	0 31	0 38	0 45
21	16	12	10	11	0 14	0 19	0 25	0 32	0 39
25	18	13	10	9	0 11	0 14	0 20	0 27	0 34
29	21	15	11	8	0 8	0 11	0 15	0 21	0 28
33	25	17	12	8	0 7	0 8	0 11	0 16	0 22
37	29	20	13	9	0 6	0 6	0 7	0 12	0 17
41	33	24	16	10	0 6	0 5	0 5	0 7	0 12
45	37	28	19	12	0 7	0 4	0 3	0 4	0 8
49	41	32	23	15	0 8	0 4	0 2	0 2	0 5
51	44	36	29	18	0 10	0 6	0 2	0 1	0 2
54	48	40	31	22	0 14	0 7	0 3	0 1	0 1
56	50	43	35	26	0 17	0 10	0 5	0 2	0 0
57	53	47	39	31	0 22	0 14	0 8	0 3	0 1
57	55	50	43	35	0 27	0 18	0 11	0 6	0 2
57	56	53	47	39	0 32	0 24	0 16	0 10	0 5
56	57	55	50	43	0 36	0 28	0 20	0 13	0 8
54	57	56	53	47	0 41	0 33	0 26	0 18	0 12
52	55	57	55	51	0 45	0 39	0 32	0 23	0 17
49	54	57	57	54	0 50	0 44	0 37	0 29	0 22
46	52	56	57	57	0 54	0 50	0 42	0 35	0 28
42	48	55	58	58	0 57	0 53	0 47	0 41	0 34

TABLE XXXIV.

The Third Equation of the Moon's Diſtance from the North Pole of the Ecliptic.

ARGUMENT A.

ARGUMENT L—E.		0 ſ.			I ſ.			II ſ.		
		0°	10°	20°	0°	10°	20°	0°	10°	20°
0 ſ.	0	28″	29″	30″	31″	32″	33″	34″	34″	35″
	10	24	25	26	27	28	29	31	32	34
	20	20	21	22	23	25	26	28	30	33
—	0	16	17	18	19	21	23	26	28	31
	10	12	13	14	16	18	20	23	26	30
	20	9	10	11	12	14	17	21	24	28
II	0	7	8	9	10	12	15	19	22	27
	10	5	6	7	9	11	13	17	21	25
	20	4	5	6	7	9	12	15	19	24
III	0	4	4	5	6	8	11	14	18	22
	10	4	4	5	6	8	10	13	17	21
	20	5	5	6	7	8	10	13	17	20
IV	0	7	7	7	8	9	11	13	16	20
	10	9	9	10	10	11	12	14	17	20
	20	12	12	12	12	13	14	15	17	19
V	0	16	16	15	15	15	16	17	18	19
	10	20	20	19	19	18	18	18	19	19
	20	24	23	23	22	22	21	20	20	20
VI	0	28	28	27	26	25	24	23	22	21
	10	33	32	31	30	29	27	26	24	23
	20	37	36	35	34	32	30	28	26	24
VII	0	41	40	39	37	35	33	31	28	25
	10	44	44	43	41	39	36	33	31	27
	0	47	47	46	44	42	39	36	32	29
VIII	0	50	49	48	46	44	41	38	34	31
	10	52	52	50	48	46	43	40	36	32
	20	53	52	51	50	48	44	41	37	33
IX	0	53	53	52	51	48	45	42	39	35
	10	53	52	52	51	49	46	43	40	36
	20	52	52	51	50	48	46	43	40	36
X	0	50	50	50	49	48	45	43	40	37
	10	47	48	48	47	46	45	43	40	37
	20	44	44	45	44	44	43	42	40	38
XI	0	41	41	42	42	41	41	40	39	37
	10	37	37	38	38	39	39	38	37	37
	20	33	33	34	35	35	36	36	36	36
		28	29	30	31	32	33	34	34	35

Continuation of TABLE XXXIV.

ARGUMENT A.

	III ſ.			IV ſ.			V ſ.			
	0°	10°	20°	0°	10°	20°	0°	10°	20°	30°
ARGUMENT L — E.	36″	37″	37″	37″	36″	35″	34″	32″	30″	28″
	36	37	38	38	39	38	38	36	35	33
	35	37	39	40	41	41	41	40	39	38
	34	37	40	41	43	44	45	44	43	42
	33	37	40	42	45	47	47	47	47	46
	32	36	40	43	46	48	50	50	51	50
	31	35	39	43	46	49	51	53	53	53
	30	34	39	43	47	50	53	54	55	55
	28	33	37	42	46	50	53	55	56	57
	27	31	36	41	45	49	52	54	56	57
	25	30	35	39	43	48	51	53	55	57
	24	28	33	37	42	45	49	52	54	55
	23	27	31	35	39	43	46	49	51	53
	23	26	29	32	36	40	44	46	48	50
	22	24	27	30	33	37	40	43	45	46
	21	23	25	28	30	33	36	38	41	42
	20	21	23	25	27	29	32	34	36	38
	20	20	21	23	24	25	27	29	31	33
	21	20	20	20	21	22	23	24	26	28
	21	20	19	18	18	18	19	20	22	24
	22	19	18	16	16	14	15	16	17	18
	23	20	17	15	13	13	12	12	13	14
	24	20	17	14	12	10	9	9	9	10
	25	21	17	14	11	9	7	6	6	7
	26	21	18	13	10	7	5	4	4	4
	27	23	18	14	10	7	4	3	2	2
	29	24	19	15	11	7	4	2	1	0
	30	25	20	16	12	8	5	2	1	0
	31	27	22	17	13	9	6	3	2	0
	33	28	24	19	15	11	8	5	3	2
	34	30	26	22	18	14	10	7	5	4
	35	31	28	24	20	17	13	11	9	7
	35	33	30	27	23	20	17	14	12	10
	36	34	32	29	27	24	21	18	16	14
	36	35	33	31	30	28	25	23	21	18
	36	36	35	34	33	31	30	27	25	24
	36	37	37	37	36	35	34	32	30	28

Continuation of TABLE XXXIV.

ARGUMENT A.

ARGUMENT L — E.		VI f.			VII f.			VIII f.		
		0°	100	20		10°	20°	0°	10°	20°
O f.	0°	28″	26″	24″	23″	22″	21′	20′	20″	20″
	10	33	31	29	27	25	24	23	21	20
	20	38	36	34	32	29	27	25	23	21
I	0	42	41	38	36	33	30	28	25	23
	10	46	45	43	40	37	33	30	27	24
	20	50	48	46	44	40	36	33	29	26
II	0	53	51	49	46	43	39	35	31	27
	10	55	54	52	49	46	42	37	33	28
	20	57	55	54	51	48	43	39	35	30
III	0	57	56	54	52	49	45	41	36	31
	10	57	55	54	53	50	46	42	37	33
	20	55	55	54	52	50	47	43	39	34
IV	0	53	54	52	51	49	46	43	39	35
	10	50	51	50	50	48	46	43	40	36
	20	46	47	48	47	47	45	43	40	37
V	0	42	43	44	45	44	43	41	40	37
	10	38	39	40	41	41	41	40	38	37
	20	33	35	36	38	38	39	38	38	37
VI	0	28	30	32	34	35	36	37	37	37
	10	24	25	27	30	31	33	34	35	36
	20	18	21	23	25	27	30	32	33	35
VII	0	14	16	18	21	24	27	29	32	34
	10	10	12	14	17	20	23	27	30	33
	20	7	9	11	13	17	20	24	28	31
VIII	0	4	5	7	10	14	18	22	26	30
	10	2	3	5	8	11	15	19	24	28
	20	0	2	3	6	9	13	17	22	27
IX	0	0	0	2	4	8	12	16	20	25
	10	0	1	2	4	7	11	15	19	24
	20	2	2	3	4	7	10	14	18	23
X	0	4	4	4	5	7	10	13	18	21
	10	7	6	6	7	9	11	14	17	21
	20	10	9	8	9	10	12	14	17	20
XI	0	14	13	12	12	13	13	15	17	20
	10	18	17	16	15	14	16	16	18	20
	20	24	22	20	19	18	18	18	19	20
	30	28	26	21	23	22	21	20	20	20

Con-

Continuation of Table XXXIV.

ARGUMENT A.

	IX ſ.			X ſ.			XI ſ.			
	0°	10°	20°	0°	10°	20°	0°	10°	20°	30°
ARGUMENT L—E.	21″	21″	22″	23″	24″	25″	26″	27″	28″	28″
	20	20	20	20	21	22	22	23	24	24
	20	19	19	18	18	19	19	19	20	20
	21	19	18	17	16	15	15	15	16	16
	22	19	17	15	14	13	13	12	12	12
	23	19	16	14	12	11	10	10	9	9
	23	19	16	13	11	9	8	7	7	7
	24	20	17	14	10	8	7	6	5	5
	25	21	17	14	10	8	6	5	4	4
	27	22	18	15	11	8	6	5	4	4
	28	24	19	15	12	9	7	5	5	4
	30	25	21	17	13	11	9	7	6	5
	31	27	22	19	15	12	10	9	8	7
	32	28	24	21	17	14	12	11	10	9
	33	30	26	23	20	18	16	14	13	12
	34	31	28	26	23	21	19	18	16	16
	35	33	30	28	26	25	23	22	21	20
	36	34	32	31	29	28	27	26	25	24
	36	35	34	34	33	32	31	30	29	28
	36	36	36	36	36	35	35	34	33	33
	36	37	37	38	38	38	38	38	37	37
	36	37	39	40	41	41	42	41	41	41
	35	38	40	42	43	44	44	45	44	44
	35	37	41	43	45	46	47	48	48	47
	34	37	40	43	45	48	49	50	50	50
	33	36	40	43	46	48	50	51	52	52
	31	36	39	43	46	49	50	52	52	53
	30	35	39	42	46	48	51	52	53	53
	29	33	38	42	44	48	50	51	52	53
	27	32	36	40	43	46	48	50	52	52
	26	31	34	38	41	44	46	48	49	50
	25	29	32	36	39	42	44	45	47	47
	24	27	30	33	36	39	41	42	44	44
	23	25	28	31	33	35	37	39	40	41
	22	24	26	28	30	32	34	35	36	37
	21	23	24	26	27	29	30	31	32	33
	21	21	22	23	24	25	26	27	28	28

TABLE XXXV.

TABLE XXXV.

The Fourth Equation of the Moon's Diſtance from the North Pole of the Ecliptic.

ARGUMENT D.

Argument L—E.		0 ſ.			I ſ.			II ſ.		
		0°	10°	20°	0°	10°	20°	0°	10°	20°
0 ſ.	0°	36″	32″	27″	23′	18″	14″	0′ 10′	0′ 7″	0′ 4″
	10	39	34	30	25	21	16	0 12	0 8	0 4
	20	42	37	33	28	23	18	0 14	0 9	0 6
I	0	44	40	36	31	26	21	0 16	0 11	0 7
	10	47	43	39	34	29	24	0 19	0 15	0 10
	20	49	46	42	38	33	28	0 23	0 18	0 15
II.	0	50	48	44	40	35	31	0 27	0 23	0 19
	10	52	49	47	44	39	35	0 31	0 27	0 24
	20	52	51	49	47	43	39	0 36	0 32	0 29
III.	0	53	52	51	49	47	43	0 40	0 37	0 34
	10	52	53	52	51	49	47	0 45	0 42	0 40
	20	52	53	54	53	52	50	0 49	0 47	0 45
IV.	0	50	53	54	54	54	53	0 52	0 52	0 51
	10	49	51	53	55	56	56	0 56	0 56	0 55
	20	47	50	52	55	56	58	0 59	0 59	0 59
V.	0	44	48	51	54	57	59	1 1	1 2	1 3
	10	42	45	49	53	56	59	1 2	1 4	1 5
	20	39	43	47	51	55	58	1 2	1 5	1 7
VI.	0	36	40	45	49	54	58	1 1	1 5	1 8
	10	33	38	43	47	51	56	1 0	1 3	1 7
	20	30	35	39	44	49	54	0 58	1 3	1 6
VII.	0	27	31	36	41	46	51	0 56	1 1	1 4
	10	25	29	33	38	43	48	0 53	0 57	1 1
	20	23	26	30	34	39	44	0 49	0 54	0 57
VIII.	0	22	24	27	32	36	40	0 45	0 49	0 53
	10	20	22	25	28	33	36	0 41	0 45	0 48
	20	19	21	23	25	29	32	0 36	0 40	0 43
IX.	0	19	20	21	23	25	28	0 32	0 35	0 38
	10	19	19	19	20	22	24	0 27	0 30	0 32
	20	20	19	18	19	20	22	0 23	0 25	0 27
X.	0	22	20	18	18	18	18	0 19	0 20	0 21
	10	23	21	18	17	16	16	0 16	0 16	0 16
	20	25	22	20	17	15	14	0 14	0 13	0 13
XI.	0	27	24	20	18	15	13	0 11	0 10	0 9
	10	30	26	22	18	16	13	0 10	0 7	0 5
	20	33	30	26	21	17	13	0 9	0 6	0 3
	30	36	32	27	23	18	14	0 10	0 7	0 4

Continuation of TABLE XXXV.

ARGUMENT D.

	III ſ.			IV ſ.			VI ſ.			
	0°	10°	20	0°	10°	20°	0°	10°	20°	30°
ARGUMENT L—E.	0′ 2′	0′ 1″	0′ 1″	0′ 4″	0′ 7′	0′ 10″	16″	22″	29″	36″
	0 2	0 0	0 1	0 2	0 5	0 9	14	21	27	34
	0 3	0 1	0 1	0 2	0 5	0 9	13	19	26	33
	0 5	0 3	0 2	0 3	0 5	0 9	14	19	25	32
	0 7	0 5	0 4	0 5	0 7	0 10	14	20	24	30
	0 11	0 9	0 8	0 8	0 10	0 12	16	20	24	29
	0 16	0 13	0 12	0 12	0 13	0 15	17	21	24	29
	0 21	0 19	0 17	0 16	0 18	0 19	20	22	25	28
	0 26	0 24	0 23	0 22	0 22	0 22	23	24	26	27
	0 32	0 30	0 29	0 28	0 27	0 26	26	27	27	27
	0 38	0 36	0 35	0 34	0 33	0 31	30	29	28	27
	0 44	0 42	0 41	0 39	0 38	0 36	34	32	30	28
	0 49	0 48	0 46	0 45	0 43	0 41	38	35	32	29
	0 54	0 53	0 52	0 50	0 48	0 46	42	39	34	29
	0 59	0 59	0 57	0 55	0 53	0 50	46	41	36	30
	1 4	1 3	1 2	0 59	0 57	0 53	49	44	38	32
	1 6	1 6	1 6	1 4	1 1	0 57	52	46	40	33
	1 8	1 9	1 8	1 7	1 4	0 59	54	48	41	34
	1 10	1 11	1 10	1 8	1 5	1 1	56	50	43	36
	1 10	1 10	1 10	1 9	1 6	1 2	57	52	45	38
	1 9	1 10	1 11	1 9	1 6	1 3	58	52	46	39
	1 7	1 9	1 9	1 8	1 6	1 2	58	53	47	40
	1 5	1 6	1 7	1 6	1 4	1 1	57	52	47	42
	1 1	1 3	1 4	1 3	1 2	1 0	56	52	48	43
	0 56	0 58	1 0	0 59	0 58	0 57	54	51	47	43
	0 51	0 53	0 54	0 55	0 54	0 53	51	49	47	44
	0 45	0 48	0 49	0 50	0 50	0 49	48	47	46	45
	0 40	0 42	0 43	0 44	0 45	0 45	46	45	45	45
	0 34	0 36	0 37	0 39	0 39	0 40	42	43	44	45
	0 28	0 30	0 31	0 33	0 34	0 35	37	40	41	44
	0 23	0 24	0 25	0 27	0 29	0 31	33	37	40	43
	0 17	0 18	0 19	0 21	0 23	0 26	30	33	38	43
	0 13	0 13	0 14	0 16	0 18	0 22	26	31	36	42
	0 9	0 9	0 10	0 12	0 14	0 18	22	28	34	40
	0 5	0 6	0 6	0 8	0 11	0 15	20	26	32	39
	0 2	0 1	0 3	0 5	0 8	0 13	18	25	31	38
	0 2	0 1	0 1	0 4	0 7	0 10	16	22	29	36

Continuation of TABLE XXXV.

ARGUMENT D.

Argument L—E.		VI s. 0°	VI s. 10°	VI s. 20°	VII s. 0°	VII s. 10°	VII s. 20°	VIII s. 0°	VIII s. 10°	VIII s. 20°
O s.	0	36″	43″	50″	56″	1′ 1″	1′ 5″	1′ 8″	1′ 10″	1′ 11″
	10	34	41	48	54	0 59	1 3	1 6	1 8	1 9
	20	33	40	46	52	0 57	1 1	1 4	1 5	1 6
I	0	32	38	44	49	0 53	0 57	1 0	1 2	1 3
	10	31	36	41	46	0 50	0 53	0 55	0 57	0 59
	20	30	34	38	42	0 46	0 48	0 50	0 52	0 53
II	0	29	32	35	38	0 41	0 43	0 45	0 46	0 48
	10	28	30	32	34	0 36	0 38	0 39	0 41	0 42
	20	27	28	29	30	0 31	0 33	0 34	0 35	0 36
III	0	27	27	27	26	0 26	0 27	0 28	0 29	0 30
	10	27	26	25	23	0 22	0 22	0 22	0 23	0 24
	20	28	25	23	20	0 19	0 17	0 17	0 17	0 19
IV	0	29	25	21	18	0 15	0 13	0 12	0 12	0 13
	10	30	25	20	16	0 12	0 10	0 8	0 8	0 9
	20	31	25	19	14	0 10	0 7	0 5	0 4	0 5
V.	0	32	25	19	14	0 9	0 6	0 3	0 2	0 3
	10	33	26	20	14	0 9	0 5	0 2	0 1	0 1
	20	34	27	21	14	0 9	0 6	0 2	0 1	0 0
VI.	0	36	28	22	16	0 10	0 7	0 4	0 2	0 1
	10	38	30	24	18	0 13	0 9	0 6	0 3	0 2
	20	39	32	26	20	0 15	0 11	0 8	0 6	0 5
VII.	0	40	34	28	23	0 18	0 14	0 12	0 10	0 9
	10	41	36	31	26	0 22	0 19	0 16	0 14	0 13
	20	42	38	34	30	0 26	0 24	0 21	0 19	0 18
VIII.	0	43	40	37	33	0 31	0 29	0 27	0 25	0 24
	10	44	41	40	37	0 35	0 34	0 32	0 31	0 30
	20	45	43	42	41	0 40	0 39	0 38	0 37	0 36
IX.	0	45	45	45	45	0 45	0 45	0 44	0 43	0 42
	10	45	46	47	48	0 49	0 50	0 50	0 49	0 48
	20	44	47	49	51	0 53	0 54	0 55	0 54	0 53
X.	0	43	47	51	54	0 57	0 59	0 59	0 59	0 58
	10	42	47	52	56	0 59	1 2	1 3	1 3	1 3
	20	41	47	53	57	1 1	1 4	1 6	1 6	1 6
X.	0	40	47	53	58	1 2	1 5	1 8	1 9	1 8
	10	39	46	52	58	1 3	1 6	1 9	1 10	1 9
	20	38	45	51	57	1 2	1 6	1 9	1 10	1 10
	30	36	43	50	56	1 1	1 5	1 8	1 10	1 11

Con-

Continuation of TABLE XXXV.

ARGUMENT D.

ARGUMENT L—E.

IX ſ.			X ſ.			XI ſ.			
0°	10°	20°	0°	10°	20°	0°	10°	20°	30°
1′ 10″	1′ 8″	1′ 5″	1′ 1′	58″	54″	49″	44″	40″	36″
1 8	1 7	1 5	1 2	58	55	51	47	43	39
1 6	1 5	1 4	1 2	59	56	53	49	45	42
1 3	1 3	1 2	1 1	59	57	54	51	48	44
0 59	0 59	0 59	0 59	58	56	54	52	50	47
0 54	0 55	0 56	0 56	56	55	54	53	51	49
0 49	0 50	0 52	0 53	54	54	54	53	52	50
0 44	0 45	0 47	0 49	51	52	53	53	53	51
0 38	0 40	0 42	0 45	47	49	51	52	53	52
0 32	0 34	0 37	0 40	43	46	49	51	52	53
0 26	0 29	0 32	0 36	39	43	46	49	51	52
0 21	0 24	0 27	0 31	35	39	43	47	49	51
0 16	0 19	0 23	0 27	31	36	40	44	48	50
0 11	0 15	0 19	0 23	28	33	37	42	46	49
0 7	0 10	0 15	0 19	24	29	34	39	43	47
0 5	0 7	0 11	0 16	21	26	31	36	40	44
0 3	0 6	0 9	0 13	18	23	28	33	37	42
0 2	0 5	0 8	0 12	16	20	25	30	34	39
0 2	0 4	0 7	0 11	14	18	23	27	32	36
0 3	0 4	0 6	0 10	13	17	21	25	30	33
0 5	0 6	0 8	0 10	13	16	19	22	27	30
0 9	0 9	0 10	0 11	13	15	18	20	24	27
0 13	0 13	0 13	0 13	14	15	17	19	22	25
0 17	0 17	0 16	0 16	16	16	17	18	21	23
0 23	0 21	0 20	0 19	18	18	18	18	20	21
0 28	0 27	0 25	0 23	21	20	19	18	19	20
0 34	0 32	0 30	0 27	24	22	21	19	19	19
0 40	0 38	0 35	0 32	28	25	23	21	20	19
0 46	0 43	0 40	0 36	32	29	25	23	21	19
0 51	0 48	0 45	0 40	36	33	28	25	22	20
0 56	0 53	0 49	0 45	40	36	31	27	24	21
1 1	0 57	0 53	0 49	44	39	34	30	26	23
1 4	1 1	0 57	0 53	48	43	38	33	29	25
1 7	1 4	1 0	0 56	51	46	41	36	32	27
1 8	1 5	1 2	0 58	54	49	44	39	35	30
1 9	1 6	1 3	1 0	56	51	46	42	38	33
1 10	1 8	1 5	1 1	58	54	49	44	40	36

TABLE XXXVI.

PARALLAX of the MOON.

ARGUMENT A.

A	Sig. O.	I.	II.	III.	IV.	V.	
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
0	53 3	53 24	54 21	55 49	57 26	58 45	30
1	53 3	53 25	54 24	55 52	57 29	58 47	29
2	53 3	53 26	54 26	55 55	57 32	58 48	28
3	53 3	53 28	54 29	55 59	57 35	58 50	27
4	53 4	53 29	54 31	56 2	57 38	58 52	26
5	53 4	53 31	54 34	56 5	57 41	58 54	25
6	53 4	53 32	54 37	56 8	57 44	58 56	24
7	53 4	53 34	54 39	56 12	57 47	58 57	23
8	53 5	53 35	54 42	56 15	57 50	58 58	22
9	53 5	53 37	54 45	56 18	57 53	59 0	21
10	53 5	53 39	54 48	56 21	57 56	59 1	20
11	53 6	53 40	54 51	56 24	57 59	59 3	19
12	53 6	53 42	54 53	56 27	58 2	59 4	18
13	53 7	53 44	54 56	56 31	58 4	59 5	17
14	53 8	53 46	54 59	56 34	58 7	59 6	16
15	53 8	53 48	55 2	56 38	58 10	59 7	15
16	53 9	53 50	55 5	56 41	58 12	59 8	14
17	53 10	53 52	55 8	56 44	58 15	59 9	13
18	53 10	53 54	55 11	56 48	58 18	59 10	12
19	53 11	53 56	55 14	56 51	58 20	59 11	11
20	53 12	53 58	55 17	56 54	58 23	59 12	10
21	53 13	54 0	55 20	56 57	58 25	59 12	9
22	53 14	54 2	55 23	57 1	58 27	59 13	8
23	53 15	54 5	55 26	57 4	58 30	59 14	7
24	53 16	54 7	55 29	57 7	58 32	59 14	6
25	53 17	54 9	55 33	57 10	58 34	59 15	5
26	53 18	54 12	55 36	57 14	58 36	59 15	4
27	53 20	54 14	55 39	57 17	58 39	59 15	3
28	53 21	54 16	55 42	57 20	58 41	59 15	2
29	53 22	54 19	55 46	57 23	58 43	59 15	1
30	53 24	54 21	55 49	57 26	58 45	59 15	0
	XI.	X.	IX.	VIII.	VII.	VI.	A

TABLE XXXVII.

First Equation of the Parallax.

ARGUMENT B.

B.	Sig. O.	I.	II.	III.	IV.	V.	
	″	″	″	″	′ ″	′ ″	
0	0.0	4.5	16.4	33.2	0 50.4	1 3.1	30
1	0.0	4.7	16.9	33.8	0 50.9	1 3.4	29
2	0.0	5.0	17.4	34.4	0 51.4	1 3.7	28
3	0.1	5.3	17.9	35.0	0 51.9	1 4.0	27
4	0.1	5.6	18.4	35.6	0 52.4	1 4.3	26
5	0.1	5.9	18.9	36.2	0 53.0	1 4.6	25
6	0.2	6.2	19.4	36.7	0 53.5	1 4.9	24
7	0.2	6.6	20.0	37.3	0 54.0	1 5.1	23
8	0.3	7.0	20.6	37.9	0 54.5	1 5.4	22
9	0.4	7.3	21.2	38.5	0 55.0	1 5.6	21
10	0.5	7.7	21.7	39.1	0 55.4	1 5.8	20
11	0.6	8.1	22.3	39.7	0 55.9	1 6.0	19
12	0.8	8.4	22.9	40.3	0 56.3	1 6.2	18
13	0.9	8.8	23.4	40.9	0 56.8	1 6.4	17
14	1.1	9.2	23.9	41.5	0 57.2	1 6.6	16
15	1.2	9.6	24.4	42.1	0 57.6	1 6.8	15
16	1.3	10.0	24.9	42.6	0 58.1	1 7.0	14
17	1.5	10.4	25.5	43.1	0 58.5	1 7.1	13
18	1.6	10.8	26.1	43.7	0 58.9	1 7.2	12
19	1.8	11.2	26.7	44.3	0 59.3	1 7.4	11
20	2.0	11.6	27.3	44.9	0 59.7	1 7.5	10
21	2.2	12.0	27.9	45.4	1 0.1	1 7.6	9
22	2.4	12.5	28.5	46.0	1 0.4	1 7.7	8
23	2.6	13.0	29.1	46.6	1 0.8	1 7.8	7
24	2.9	13.5	29.7	47.1	1 1.2	1 7.8	6
25	3.2	14.0	30.2	47.7	1 1.6	1 7.9	5
26	3.4	14.4	30.8	48.3	1 2.0	1 7.9	4
27	3.6	14.9	31.4	48.9	1 2.3	1 7.9	3
28	3.9	15.4	32.0	49.4	1 2.6	1 8.0	2
29	4.2	15.9	32.6	49.9	1 2.9	1 8.0	1
30	4.5	16.4	33.2	50.4	1 3.1	1 8.0	0
	XI.	X.	IX.	VIII.	VII.	VI.	B.

TABLE XXXVIII.

TABLE XXXVIII.

The Second Equation of the Parallax.

ARGUMENT C.

	O.	I.	II.	III.	IV.	V.	
	″	″	″	″	″	″	
0	56.2	41.6	13.6	0.0	13.6	41.6	30
1	56.2	40.8	12.8	0.0	14.4	42.5	29
2	56.1	39.9	12.0	0.1	15.3	43.4	28
3	56.0	39.0	11.2	0.2	16.2	44.2	27
4	55.9	38.1	10.4	0.3	17.1	45.0	26
5	55.8	37.2	9.7	0.4	18.0	45.8	25
6	55.6	36.3	9.0	0.6	18.9	46.6	24
7	55.3	35.3	8.4	0.9	19.8	47.2	23
8	55.0	34.3	7.8	1.1	20.7	47.8	22
9	54.7	33.3	7.2	1.3	21.7	48.5	21
10	54.4	32.4	6.6	1.6	22.6	49.2	20
11	54.0	31.4	6.0	2.0	23.6	49.8	19
12	53.6	30.4	5.4	2.4	24.6	50.4	18
13	53.2	29.5	4.8	2.8	25.5	51.0	17
14	52.7	28.5	4.2	3.2	26.5	51.6	16
15	52.2	27.5	3.7	3.7	27.5	52.2	15
16	51.6	26.5	3.2	4.2	28.5	52.7	14
17	51.0	25.5	2.8	4.8	29.5	53.2	13
18	50.4	24.6	2.4	5.4	30.4	53.6	12
19	49.8	23.6	2.0	6.0	31.4	54.0	11
20	49.2	22.6	1.6	6.6	32.4	54.4	10
21	48.5	21.7	1.3	7.2	33.3	54.7	9
22	47.8	20.7	1.1	7.8	34.3	55.0	8
23	47.2	19.8	0.9	8.4	35.3	55.3	7
24	46.6	18.9	0.6	9.0	36.3	55.6	6
25	45.8	18.0	0.4	9.7	37.2	55.8	5
26	45.0	17.1	0.3	10.4	38.1	55.9	4
27	44.2	16.2	0.2	11.2	39.0	56.0	3
28	43.4	15.3	0.1	12.0	39.9	56.1	2
29	42.5	14.4	0.0	12.8	40.8	56.2	1
30	41.6	13.6	0.0	13.6	41.6	56.2	0
	XI.	X.	IX.	VIII.	VII.	VI.	C.

TABLE XXXIX.

Third Equation of the Parallax.

ARGUMENT d.

d	Equat.	d	Equat.	d	Equat.	d	Equat.
	″		″		″		″
0	0.0	260	3.2	500	6.0	760	2.8
10	0.0	270	3.4	510	6.0	770	2.6
20	0.0	280	3.6	520	6.0	780	2.4
30	0.1	290	3.7	530	5.9	790	2.3
40	0.1	300	3.9	540	5.9	800	2.1
50	0.2	310	4.1	550	5.8	8 0	1.9
60	0.2	320	4.3	560	5.8	820	1.7
70	0.3	330	4.4	570	5.7	8 0	1.6
80	0.4	340	4.6	580	5.6	840	1.4
90	0.5	350	4.8	590	5.5	850	1.2
100	0.6	360	4.9	600	5.4	860	1.1
110	0.7	370	5.0	610	5.3	870	1.0
120	0.8	380	5.2	620	5.2	880	0 8
130	1.0	390	5.3	630	5.0	890	0.7
140	1.1	400	5.4	640	4.9	900	0.6
150	1.2	410	5.5	650	4.8	910	0.5
160	1.4	420	5.6	660	4.6	920	0 4
170	1.6	430	5.7	670	4.4	930	0.3
180	1.7	440	5.8	680	4.3	940	0.2
190	1.9	450	5.8	690	4.1	950	0.2
200	2.1	460	5.9	700	3.9	960	0.1
210	2.3	470	5.9	710	3.7	970	0.1
220	2.4	480	6.0	720	3.6	980	0.0
230	2.6	490	6.0	730	3.4	990	0.0
240	2.8	500	6.0	740	3.2	0	0.0
250	3.0			750	3.0		

Supplemental Equations of the Parallax.

TABLE XL.

ARGUMENT b.			
b	Equat.	b	Equat.
	″		″
0	3.6	525	0.4
25	3.6	550	0.5
50	3.5	575	0.6
75	3.4	600	0.7
100	3.3	625	0.9
125	3.1	650	1.1
150	2.9	675	1.3
175	2.7	700	1.5
200	2.5	725	1.7
225	2.3	750	2.0
250	2.0	775	2.3
275	1.7	800	2.5
300	1.5	825	2.7
325	1.3	850	2.9
350	1.1	875	3.1
375	0.9	900	3.3
400	0.7	925	3.4
425	0.6	950	3.5
450	0.5	975	3.6
475	0.4	0	3.6
500	0.4		

TABLE XLI.

ARGUMENT c.			
c	Equat.	c	Equat.
	″		″
0	0.3	525	3.7
25	0.3	550	3.6
50	0.4	575	3.5
75	0.5	600	3.4
100	0.6	625	3.2
125	0.8	650	3.0
150	1.0	675	2.8
175	1.2	700	2.6
200	1.4	725	2.3
225	1.7	750	2.0
250	2.0	775	1.7
275	2.3	800	1.4
300	2.6	825	1.2
325	2.8	850	1.0
350	3.0	875	0.8
375	3.2	900	0.6
400	3.4	925	0.5
425	3.5	950	0.4
450	3.6	975	0.3
475	3.7	0	0.3
500	3.7		

Supplemental Equations of the Parallax.

TABLE XLII.

ARGUMENT e.			
e	Equat.	e	Equat.
	″		″
0	3.2	525	0.8
25	3.2	550	0.9
50	3.1	575	0.9
75	3.1	600	1.0
100	3.0	625	1.1
125	2.9	650	1.2
150	2.8	675	1.4
175	2.6	700	1.6
200	2.4	725	1.8
225	2.2	750	2.0
250	2.0	775	2.2
275	1.8	800	2.4
300	1.6	825	2.6
325	1.4	850	2.8
350	1.2	875	2.9
375	1.1	900	3.0
400	1.0	925	3.1
425	0.9	950	3.1
450	0.9	975	3.2
475	0.8	0	3.2
500	0.8		

TABLE XLIII.

ARGUMENT f.			
f	Equat. negat.	f	Equat. negat.
	″		″
0	5.9	525	4.1
25	5.9	550	4.1
50	5.9	575	4.2
75	5.8	600	4.3
100	5.8	625	4.3
125	5.7	650	4.5
150	5.5	675	4.6
175	5.4	700	4.7
200	5.3	725	4.9
225	5.1	750	5.0
250	5.0	775	5.1
275	4.9	800	5.3
300	4.7	825	5.4
325	4.6	850	5.5
350	4.5	875	5.7
375	4.3	900	5.8
400	4.3	925	5.8
425	4.2	950	5.9
450	4.1	975	5.9
475	4.1	0	5.9
500	4.1		

Supplemental Equations of the Parallax.

TABLE XLIV.

ARGUMENT g.		ARGUMENT g.	
g	Negat. Equat.	g	Negat. Equat.
	″		″
0	1.7	525	0.3
25	1.7	550	0.3
50	1.7	575	0.4
75	1.6	600	0.4
100	1.6	625	0.5
125	1.5	650	0.6
150	1.4	675	0.7
175	1.3	700	0.8
200	1.2	725	0.9
225	1.1	750	1.0
250	1.0	755	1.1
275	0.9	800	1.2
300	0.8	825	1.3
325	0.7	850	1.4
350	0.6	875	1.5
375	0.5	900	1.6
400	0.4	925	1.6
425	0.4	950	1.7
450	0.3	975	1.7
475	0.3	0	1.7
500	0.3		

TABLES
OF THE
MOON's *Hourly* MOTION.

TABLE I.

The Hourly Motion of the Moon, correſponding to her Horizontal Parallax.

Horiz. Paral.	Hourly Motion.	Dif.
″	′ ′	′ ″
52	27 4. 0	1 3. 7
53	28 7. 7	1 5. 0
54	29 12. 7	1 6. 2
55	30 18. 9	1 7. 4
56	31 26. 3	1 8. 6
57	32 34. 9	1 9. 9
58	33 44. 8	1 11. 1
59	34 55. 9	1 12. 3
60	36 8. 2	1 13. 4
61	37 21. 6	1 14. 6
62	38 36. 2	1 15. 9
63	39 52. 1	

TABLE II.

The Firſt Equation of the Hourly Motion. Argument A.

A	0 ſ.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
0	0. 7	1. 6	2. 6	2. 9	3. 1	3. 4	3. 5	2. 4	1. 3	0. 9	0. 8	0. 6
10	0. 9	2. 0	2. 7	3. 0	3. 2	3. 5	3. 3	2. 0	1. 1	0. 9	0. 7	0. 6
20	1. 2	2. 3	2. 8	3. 0	3. 3	3. 6	2. 9	1. 6	1. 0	0. 9	0. 7	0. 6
30	1. 6	2. 6	2. 9	3. 1	3. 4	3. 5	2. 4	1. 3	0. 9	0. 8	0. 6	0. 7

TABLE III.

The Second Equation of the Hourly Motion. Argument B.

B	0 ſ.	I.	II.	III.	IV.	V.	VI.	VII.	VIII	IX.	X.	XI.
0	5.4	5.2	4.3	3.1	1.8	0.8	0.4	0.8	1.8	3.1	4.3	5.2
10	5.4	4.9	3.9	2.7	1.4	0.6	0.4	1.1	2.2	3.5	4.6	5.3
20	5.3	4.6	3.5	2.2	1.1	0.4	0.6	1.4	2.7	3.9	4.9	5.3
30	5.2	4.3	3.1	1.8	0.8	0.4	0.8	1.8	3.1	4.3	5.2	5.4

TABLE IV.

The Third Equation of the Hourly Motion. Argument C.

C	0 ſ.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
0	18.0	12.6	4.6	2.1	6.4	15.1	20.2	14.5	5.6	2.2	5.4	13.3
2	17.9	12.0	4.2	2.2	6.9	15.7	20.1	13.9	5.2	2.2	5.8	13.8
4	17.8	11.4	3.9	2.4	7.4	16.3	20.0	13.3	4.8	2.2	6.2	14.3
6	17.6	10.8	3.6	2.6	8.0	16.9	19.8	12.6	4.4	2.3	6.7	14.8
8	17.4	10.2	3.3	2.7	8.5	17.4	19.6	11.9	4.1	2.4	7.2	15.3
10	17.1	9.6	3.0	2.9	9.1	17.9	19.4	11.3	3.8	2.5	7.7	15.7
12	16.8	9.0	2.7	3.1	9.7	18.3	19.0	10.7	3.5	2.7	8.2	16.1
14	16.5	8.4	2.5	3.4	10.3	18.7	18.7	10.1	3.2	2.9	8.7	16.5
16	16.1	7.9	2.4	3.7	10.9	19.0	18.3	9.5	3 0	3.1	9.3	16.8
18	15.7	7.4	2.3	4.0	11.5	19.3	17.8	8.9	2.8	3.4	9.8	17.1
20	15.3	6.9	2.2	4.3	12.1	19.6	17.3	8.3	2.6	3.6	10.4	17.4
22	14.8	6.4	2.2	4.7	12.7	19.8	16.8	7.7	2.5	3.9	11.0	17.6
24	14.3	5.9	2.1	5.1	13.3	20.0	16.3	7.0	2.4	4.2	11.6	17.8
26	13.8	5.4	2.1	5.5	13.9	20.1	15.7	6.5	2.3	4.6	12.2	17.9
28	13.2	5.0	2.1	6.0	14.5	20.2	15.1	6.0	2.2	5.0	12.7	18.0
30	12.6	4.6	2.1	6.4	15.1	20.2	14.5	5.6	.2	5.4	13.3	18.0

TABLE V.

The Fourth Equation of the Horary Motion, Argument D

D	0 ſ.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
0	1.6	1.5	1.3	1.0	0.7	0.5	0.4	0.5	0.7	1.0	1.3	1.5
10	1.6	1.5	1.2	0.9	0.6	0.4	0.4	0.5	0.8	1.1	1.4	1.6
20	1.6	1.4	1.1	0.8	0.5	0.4	0.4	0.6	0.9	1.2	1.5	1.6
30	1.5	1.3	1.0	0.7	0.5	0.4	0.5	0.7	1.0	1.3	1.5	1.6

TABLE VI.

a	Fifth Equat.	a	Fifth Equat.
0	0.9	520	0.9
20	0.9	540	1.0
40	1.0	560	1.2
60	1.2	580	1.4
80	1.4	600	1.7
100	1.7	620	1.9
120	1.9	640	2.2
140	2.2	660	2.5
160	2.5	680	2.7
180	2.7	700	2.9
200	2.9	720	3.0
220	3.0	740	3.1
240	3.1	760	3.1
260	3.1	780	3.0
280	3.0	800	2.9
300	2.9	820	2.7
320	2.7	840	2.5
340	2.5	860	2.2
360	2.2	880	1.9
380	1.9	900	1.7
400	1.7	920	1.4
420	1.4	940	1.2
440	1.2	960	1.0
460	1.0	980	0.9
480	0.9	0	0.9
500	0.9		

TABLE VII.

b	Sixth Equat.	b	Sixth Equat.
0	0.7	520	1.3
20	0.7	540	1.3
40	0.7	560	1.3
60	0.7	580	1.3
80	0.7	600	1.2
100	0.8	620	1.2
120	0.8	640	1.2
140	0.8	660	1.2
160	0.8	680	1.1
180	0.9	700	1.1
200	0.9	720	1.1
220	0.9	740	1.0
240	1.0	760	1.0
260	1.0	780	0.9
280	1.1	800	0.9
300	1.1	820	0.9
320	1.1	840	0.8
340	1.2	860	0.8
360	1.2	880	0.8
380	1.2	900	0.8
400	1.2	920	0.7
420	1.3	940	0.7
440	1.3	960	0.7
460	1.3	980	0.7
480	1.3	0	0.7
500	1.3		

TABLE VIII.

c	Seventh Equat.	c	Seventh Equat.
0	0.3	520	1.7
20	0.3	540	1.7
40	0.3	560	1.6
60	0.4	580	1.6
80	0.4	600	1.6
100	0.4	620	1.5
120	0.5	640	1.4
140	0.6	660	1.4
160	0.6	680	1.3
180	0.7	700	1.2
200	0.8	720	1.1
220	0.9	740	1.0
240	1.0	760	1.0
260	1.0	780	0.9
280	1.1	800	0.8
300	1.2	820	0.7
320	1.3	840	0.6
340	1.4	860	0.6
360	1.4	880	0.5
380	1.5	900	0.4
400	1.6	920	0.4
420	1.6	940	0.4
440	1.6	960	0.3
460	1.7	980	0.3
480	1.7	0	0.3
500	1.7		

TABLE IX.

d	Eighth Equat.	d	Eighth Equat.
0	0	520	2.0
20	0	540	2.0
40	0	560	1.9
60	0.1	580	1.9
80	0.1	600	1.8
100	0.2	620	1.7
120	0.3	640	1.6
140	0.4	660	1.5
160	0.5	680	1.4
180	0.6	700	1.3
200	0.6	720	1.2
220	0.7	740	1.1
240	0.8	760	0.9
260	1.1	780	0.8
280	1.2	800	0.7
300	1.3	820	0.6
320	1.4	840	0.5
340	1.5	860	0.4
360	1.6	880	0.3
380	1.7	900	0.2
400	1.8	920	0.1
420	1.9	940	0.1
440	1.9	960	0
460	2.0	980	0
480	2.0	0	0
500	2.0		

TABLE X.

g	Ninth Equat.	g	Ninth Equat.
0	0	520	2.0
20	0	540	2.0
40	0	560	1.9
60	0.1	580	1.9
80	0.1	600	1.8
100	0.2	620	1.7
120	0.3	640	1.6
140	0.4	660	1.5
160	0.5	680	1.4
180	0.6	700	1.3
200	0.7	720	1.2
220	0.8	740	1.1
240	0.9	760	0.9
260	1.1	780	0.8
280	1.2	800	0.7
300	1.3	820	0.6
320	1.4	840	0.5
340	1.5	860	0.4
360	1.6	880	0.3
380	1.7	900	0.2
400	1.8	920	0.1
420	1.9	940	0.1
440	1.9	960	0
460	2.0	980	0
480	2.0	0	0
500	2.0		

TABLE XI.

h	Tenth Equat.	h	Tenth Equat.
0	1.9	520	0.1
20	1.9	540	0.1
40	1.9	560	0.2
60	1.8	580	0.2
80	1.8	600	0.3
100	1.7	620	0.3
120	1.7	640	0.4
140	1.6	660	0.5
160	1.5	680	0.6
180	1.4	700	0.7
200	1.3	720	0.8
220	1.2	740	0.9
240	1.1	760	1.1
260	0.9	780	1.2
280	0.8	800	1.3
300	0.7	820	1.4
320	0.6	840	1.5
340	0.5	860	1.6
360	0.4	880	1.7
380	0.3	900	1.7
400	0.3	920	1.8
420	0.2	940	1.8
440	0.2	960	1.9
460	0.1	980	1.9
480	0.1	0	1.9
500	0.1		

TABLE XII.

TABLE XII.

i	11th Equat.	i	11th Equat.
0	— 7.3	520	— 7.3
20	— 7.3	540	— 7.4
40	— 7.4	560	— 7.5
60	— 7.5	580	— 7.6
80	— 7.6	600	— 7.8
100	— 7.8	620	— 8.0
120	— 8.0	640	— 8.1
140	— 8.1	660	— 8.3
160	— 8.3	680	— 8.4
180	— 8.4	700	— 8.6
200	— 8.6	720	— 8.6
220	— 8.6	740	— 8.7
240	— 8.7	760	— 8.7
260	— 8.7	780	— 8.6
280	— 8.6	800	— 8.6
300	— 8.6	820	— 8.4
320	— 8.4	840	— 8.3
340	— 8.3	860	— 8.1
360	— 8.1	880	— 8.0
380	— 8.0	900	— 7.8
400	— 7.8	920	— 7.6
420	— 7.6	940	— 7.5
440	— 7.5	960	— 7.4
460	— 7.4	980	— 7.3
480	— 7.3	0	— 7.3
500	— 7.3		

TABLE XIII.

TABLE XIII.

The Hourly Variation of the Reduction to the Ecliptic.

ARGUMENT L.

L	VI.	VII.	VIII.	IX.	X.	XI.
	O.	I.	II.	III.	IV.	V.
0	− 8.0	− 4.0	+ 4.0	+ 8.0	+ 4.0	− 4.0
5	− 7.9	− 2.7	+ 5.1	+ 7.9	+ 2.7	− 5.1
10	− 7.5	− 1.4	+ 6.1	+ 7.5	+ 1.4	− 6.1
15	− 6.9	0	+ 6.9	+ 6.9	0	− 6.9
20	− 6.1	+ 1.4	+ 7.5	+ 6.1	− 1.4	− 7.5
25	− 5.1	+ 2.7	+ 7.9	+ 5.1	− 2.7	− 7.9
30	− 4.0	+ 4.0	+ 8.0	+ 4.0	− 4.0	− 8.0

TABLE XIV.

The Hourly Variation of the Equation given by the Table in Page 69.

L.—E	VI.	VII.	VIII.	IX.	X.	XI.
	O.	I.	II.	III.	IV.	V.
0	− 4.3	− 2.1	+ 2.1	+ 4.3	+ 2.1	− 2.1
5	− 4.2	− 1.5	+ 2.8	+ 4.2	+ 1.5	− 2.8
10	− 4.0	− 0.7	+ 3.3	+ 3.3	+ 0.7	− 3.3
15	− 3.7	0	+ 3.7	+ 4.0	0	− 3.7
20	− 3.3	+ 0.7	+ 4.0	+ 3.3	− 0.7	− 4.0
25	− 2.8	+ 1.5	+ 4.2	+ 2.8	− 1.5	− 4.2
30	− 2.1	+ 2.1	+ 4.3	+ 2.1	− 2.1	− 4.3

A Supplement to the Table of Epochs for the Arguments of the Moon's Equations.

Mean Motions to be added to the Epochs of the Years 1741, 1742, 1743 - - - - 1775,
to obtain thoſe of the Years - - - - - 1701, 1702, 1703 - - 1735.

Sup. of ☊	☾	A	B	C	D	E	
10 6 19 30	3 2 51 2	9 10 31 32	8 25 47 18	3 3 9 25	0 0 25	8 12 3	

a	b	c	d	e	f	g	h	i	k	l	m	n	o	p
520. 48	737. 29	516. 56	296. 87	778. 25	780. 30	255. 91	438. 45	038. 1	739. 3	518. 6	295. 8	042. 0	557. 5	820. 2

The ſame ſubducted from the Epochs of the Years 1737, 1738, 1739 - - - 1776,
give thoſe of the Years - - - - 1777, 1778, 1779 - - - 1816

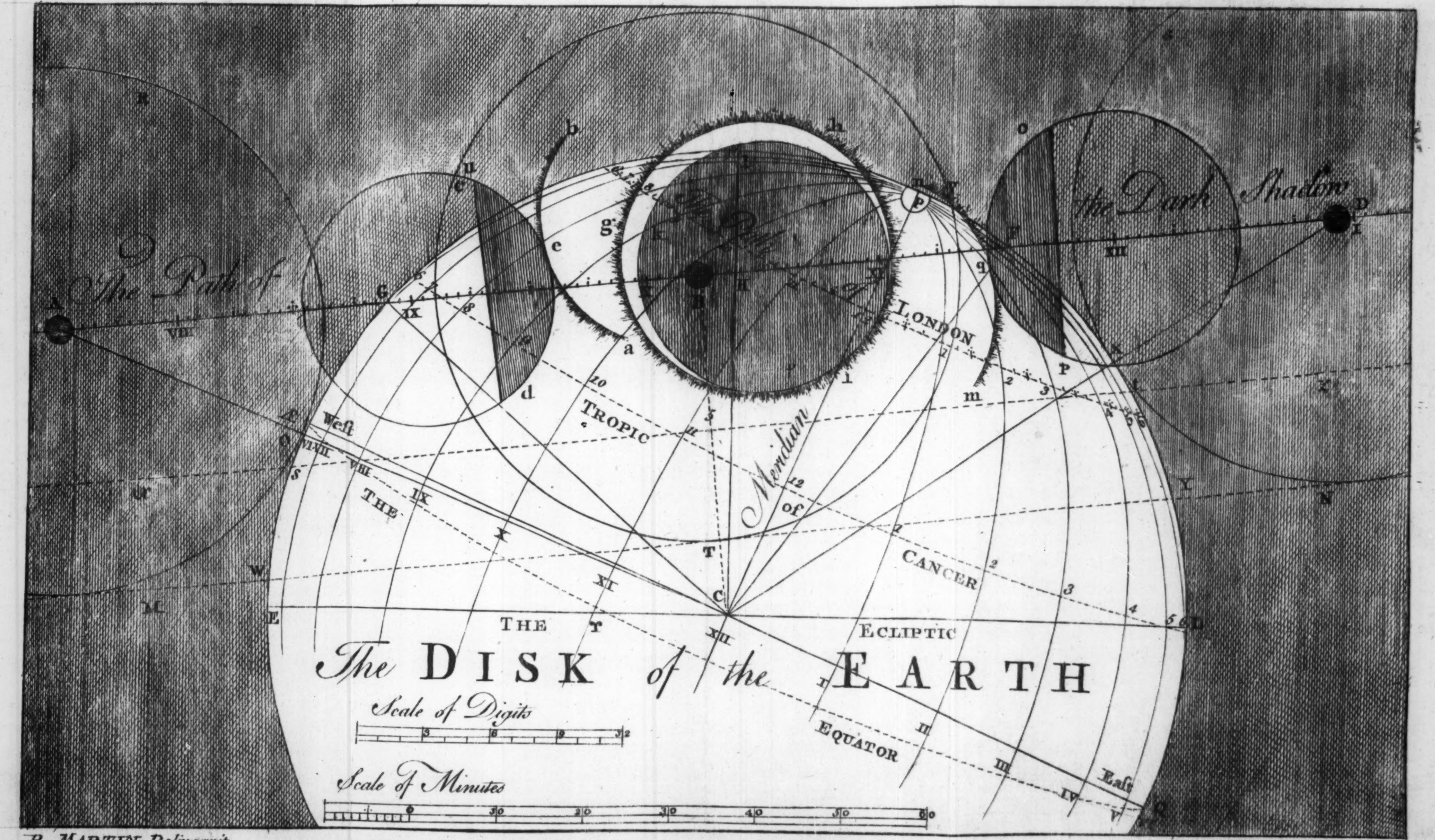
Mean Motions to be added to the Epochs of 1736, 1737, 1738 - - - 1760,
to find thoſe of the Years - - 1676, 1677, 1678 - - 1700.

Sup. of ☊	☾	A	B	C	D	E	
9 9 32 26	11 2 27 8	8 13 51 12	1 19 59 56	11 1 55 35	0 1 37	6 20 9	

a	b	c	d	e	f	g	h	i	k	l	m	n	o	p

BRITISH MUSEUM
20/6/63

The NATURE & CONSTRUCTION of a SOLAR ECLIPSE explain'd, & exemplified in that of APRIL 1st 1764; both in Regard to the EARTH in General; & particularly to the CITY of LONDON.



B. MARTIN, Delineavit.

E. Bowen Sculpsit.

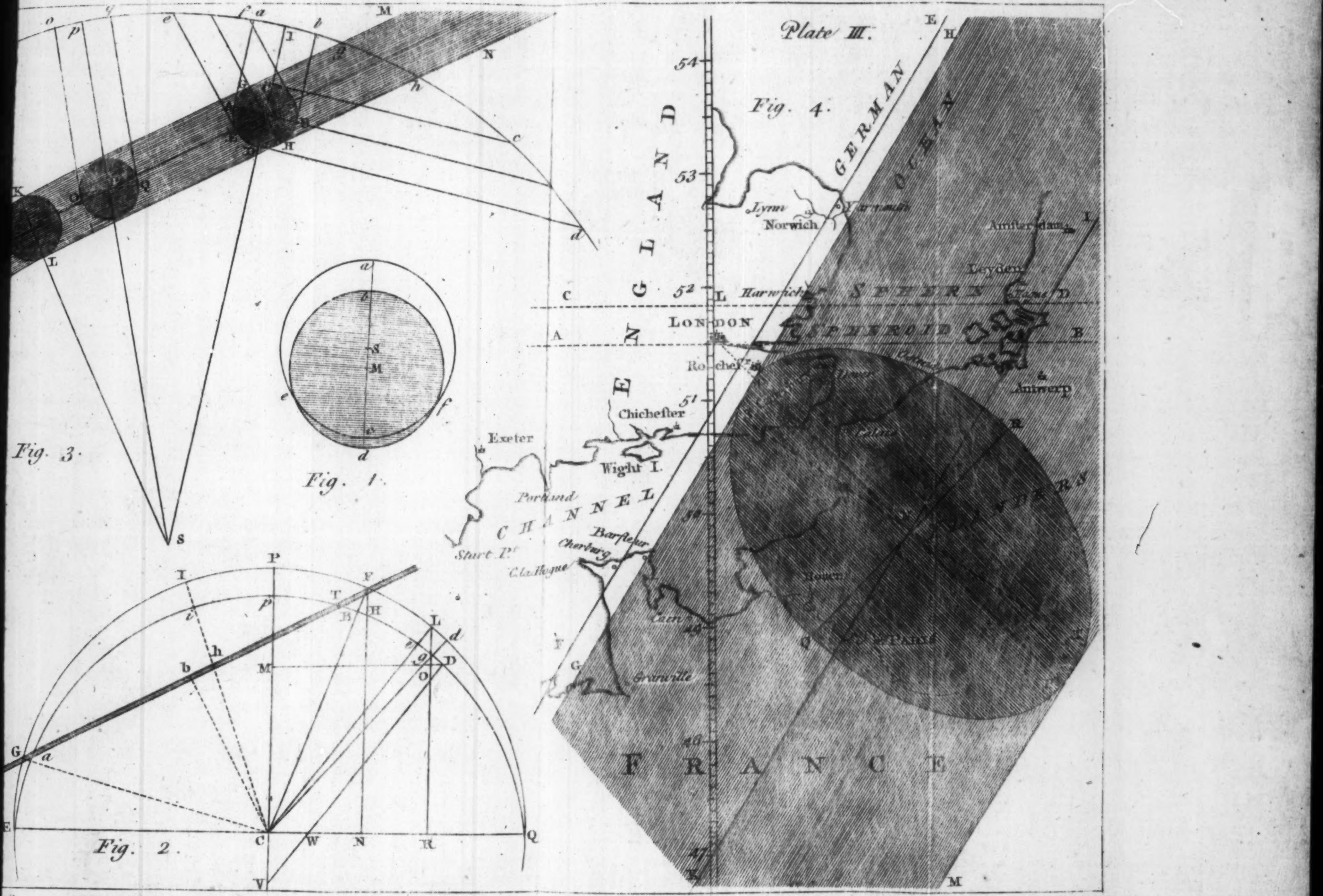
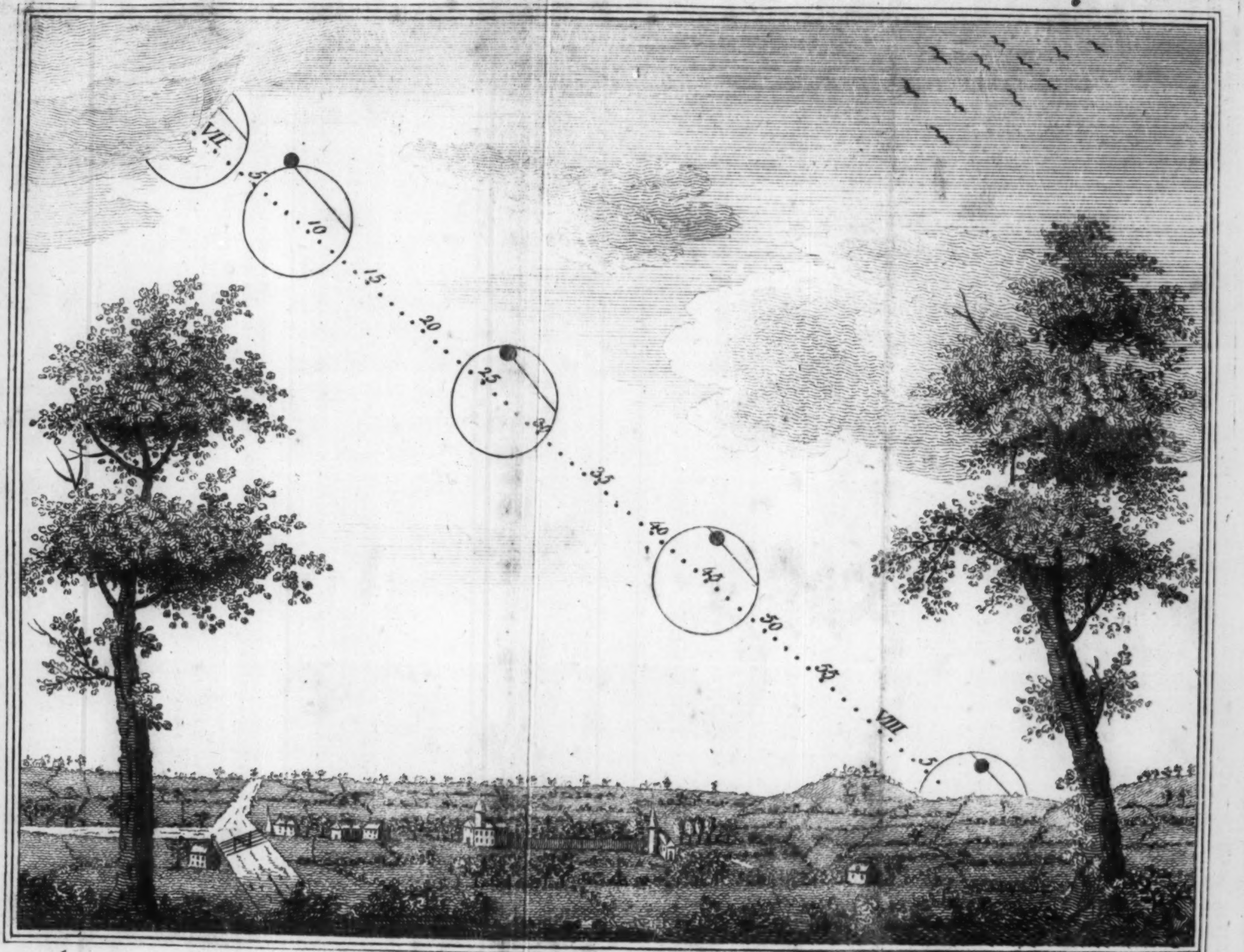


Plate III.

Fig. 3
o
q
e
f
a
M
p
I
b
N
h
c
K
Q
H
L
d
S
Fig. 1
a
b
S
M
e
f
o
d
Fig. 2
P
I
F
T
p
i
B
H
L
d
h
b
e
g
D
M
O
G
a
E
C
W
N
R
Q
V
Fig. 4
E
H
54
53
52
51
50
49
48
47
GERMAN
OCEAN
ENGLAND
Lynn
Norwich
Yarmouth
Amsterdam
Leyden
C
L
Harwich
D
SPHERE
LONDON
SPHEROID
A
B
Rochester
Dover
Antwerp
Chichester
Exeter
Wight I.
Portland
CHANNEL
FLANDERS
Start Pt
Barfleur
Cherburg
C. la Hague
Rouen
Caen
Paris
F
G
Granville
Q
R
FRANCE
K
M



An Artificial VIEW *of the* TRANSIT *of* VENUS *June* 3^{d} *1769*
at LONDON, *in a large* CELESTIAL LANDSCAPE.